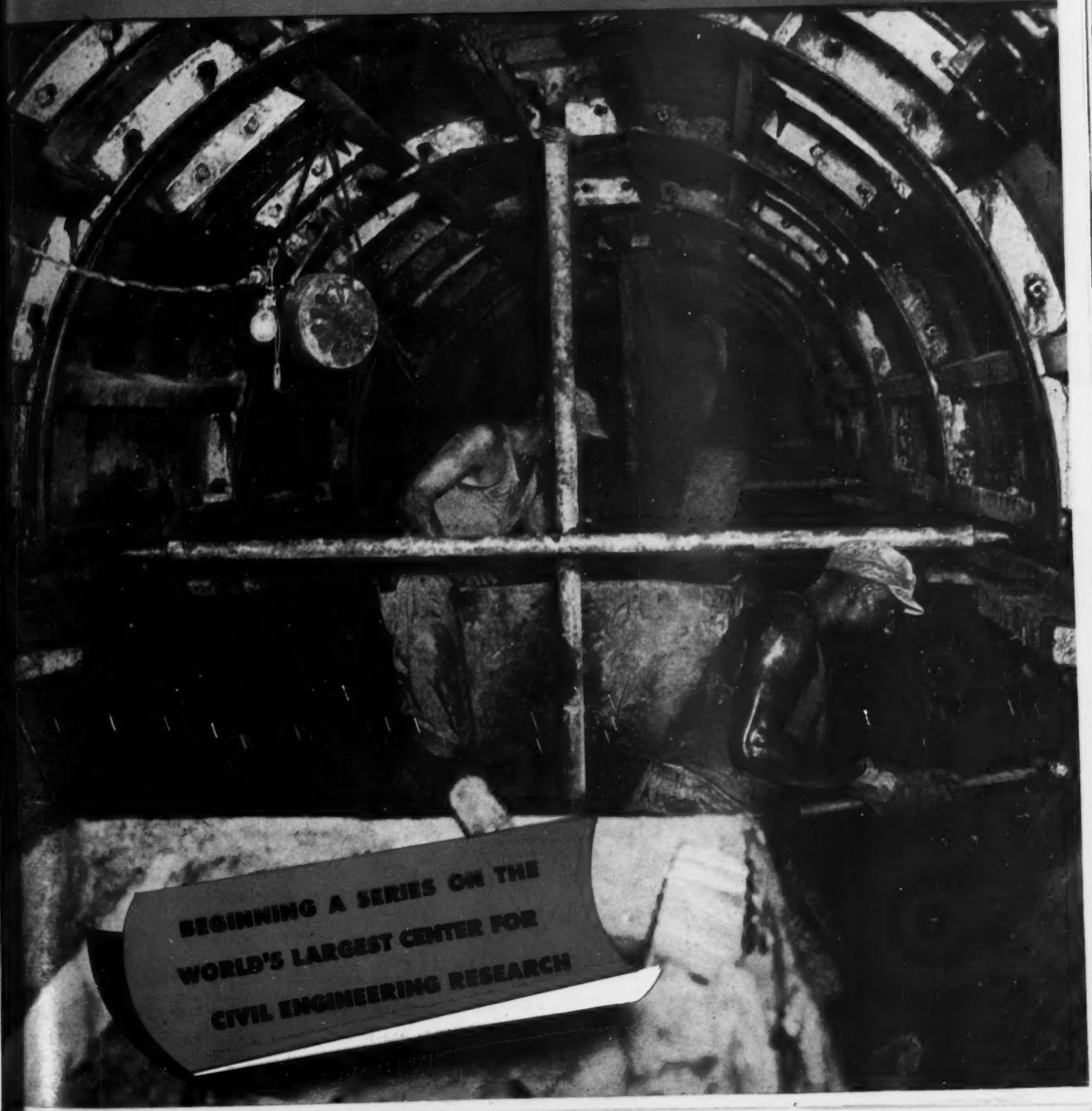
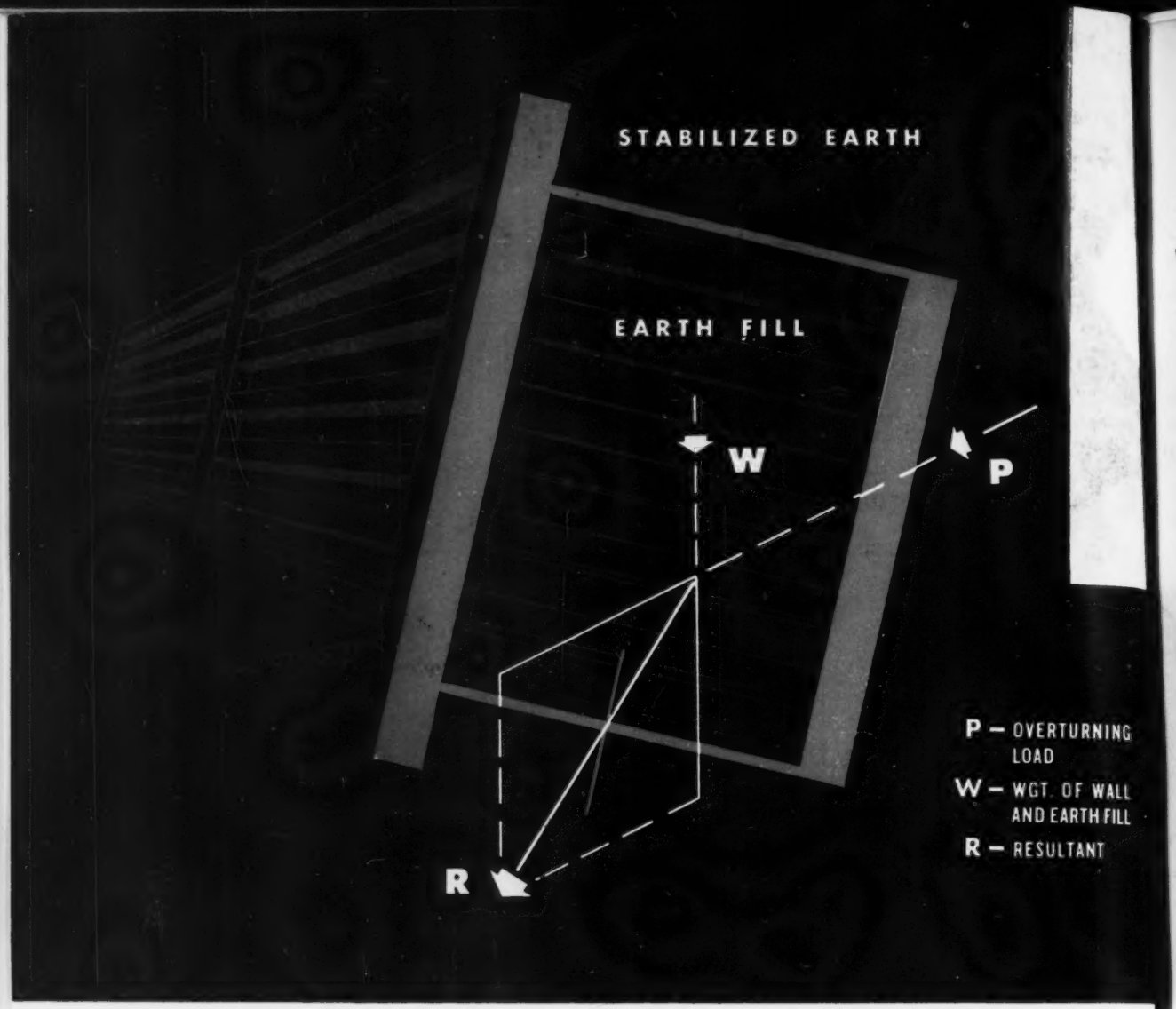
ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

SEPTEMBER 18, 1947

Setting forms for a sewer tunnel under Washington.





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ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Docks, Railroads

Volume 139 • Number 12

September 18, 1947

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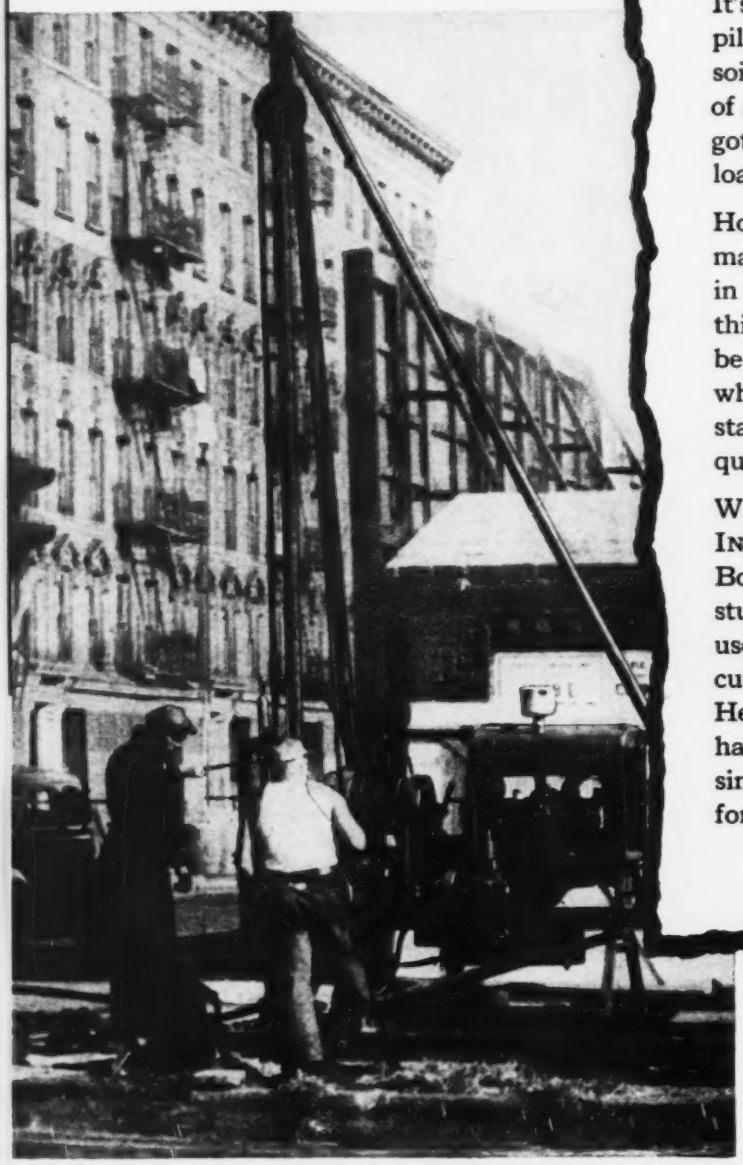
THE PILES SUPPORT THE STRUCTURE . . .

But What Supports the Piles?



It's the soil that actually bears the load, not the piles. The piles simply transfer the load to the soil. So it isn't just a matter of installing piles of a given depth and a given diameter. You've got to make sure that the soil can carry the load the piles will transfer to it.

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Construction Trends

Waterworks Contract Awards Running 7% Ahead of a Year Ago

The volume of waterworks contracts totals $75,007,000 for the first 36 weeks of 1947, as recorded by *Engineering News-Record*, compared with $70,102,000 in the corresponding period a year ago. Thus, contracts awarded so far this year are 7 percent above the 1946 volume. If the contract volume maintains its present relative advantage over a year ago, the 1947 total may reach approximately $116,800,000 as against $109,159,000 last year.

Of the total volume of contract awards of $75,007,000, $73,055,000, or 97 percent went for state, district, county and municipal work. In the same period a year ago $66,655,000 went for non-federal jobs, or 95 percent of the total.

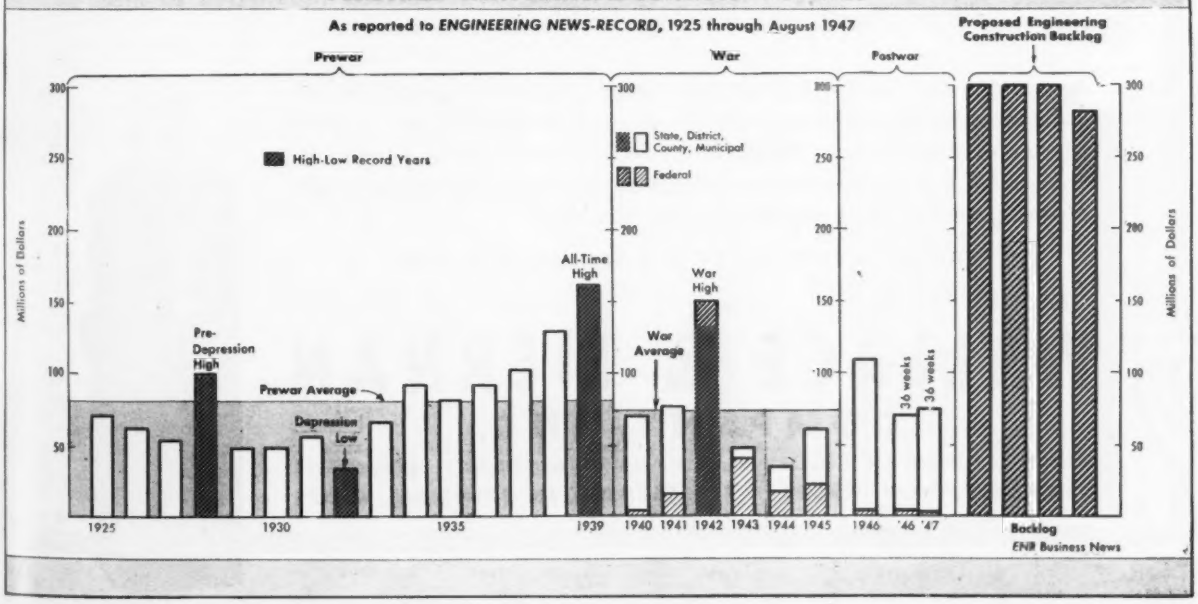
During the war years, and especially in 1943 and 1944 when only 20 and 40 percent, respectively, of the annual totals went for state, district, county and municipal projects, more federal funds were made available for waterworks construction. In 1941 approximately 20 percent of the total volume went for federal contracts; in 1942, 12 percent; in 1943, 80 percent; in 1944, 64 percent and in 1945, 34 percent. Since 1945, however, federal projects have resumed a relatively more normal position, dropping to 4 percent of the annual total in 1946 and to 3 percent of the cumulative total so far this year.

An analysis of the geographical distribution of waterworks contracts awarded in the U. S. shows the Far West accounting for 29 percent of the total so far this year, or for $21,575,000. Other sections recorded the following totals: Middle Atlantic, $15,534,000, or 21 percent; West of the Mississippi, $12,713,000, or 17 percent; Middle West, $12,482,000, or 17 percent; South, $10,953,000, or 14 percent; and New England, $1,750,000, or 2 percent.

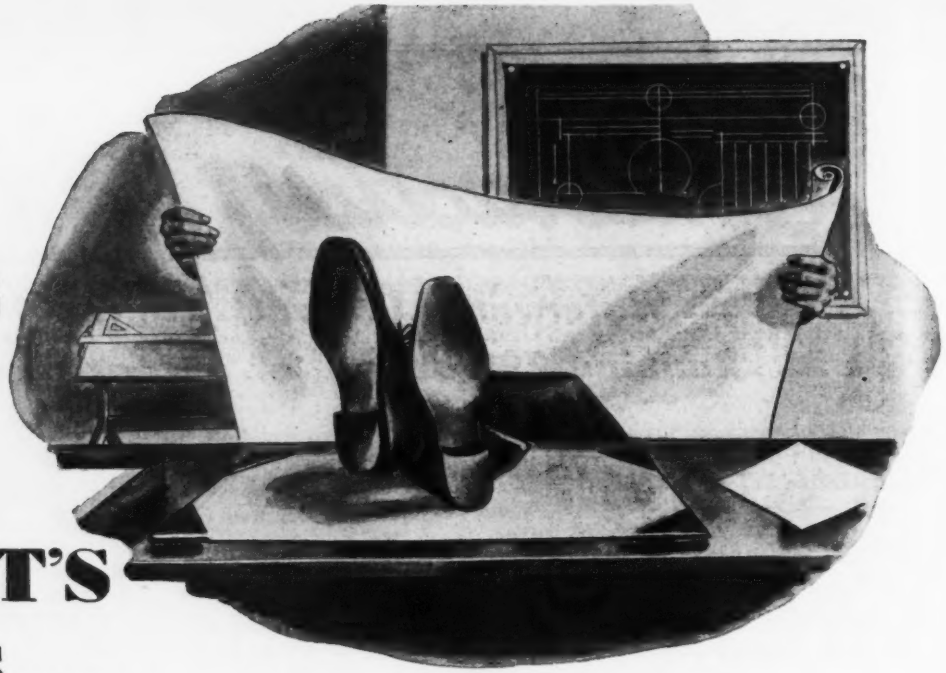
The contract volume for the Far West showed a gain of 90 percent over the corresponding 1946 period. The Middle West showed a gain of 62 percent and the South of 12 percent. New England, Middle Atlantic and West of the Mississippi registered losses of 52 percent, 35 percent and 6 percent, respectively.

At the end of August 1947, the backlog of proposed waterworks construction amounted to $1,131,696,000 based on 1940, 1943, 1944, 1945, 1946 and 1947 costs and values. This backlog is equivalent to approximately 12 years of construction activity at the present rate of contract awards.

PROPOSED BACKLOG OF WATERWORKS CONSTRUCTION COMPARED WITH ANNUAL CONTRACT VOLUMES



IF WE WERE IN YOUR CLIENT'S SHOES...



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FLEXIBILITY—so that the chlorinator installed today would be adaptable to future changes.

LONG LIFE—to give us full value from our investment.

DEPENDABILITY—for positive, unfailing protection.

SIMPLICITY—so that the operator need not be a "gadgeteer" to keep it working.

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A MANUFACTURER WITH EXPERIENCE—to back up his recommendations and insure a job-engineered installation to meet our particular needs.

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Your W & T Representative will always be glad to give you details on equipment to meet *any* chlorination problem.

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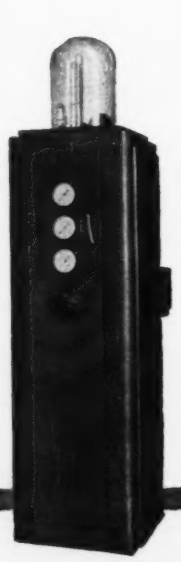

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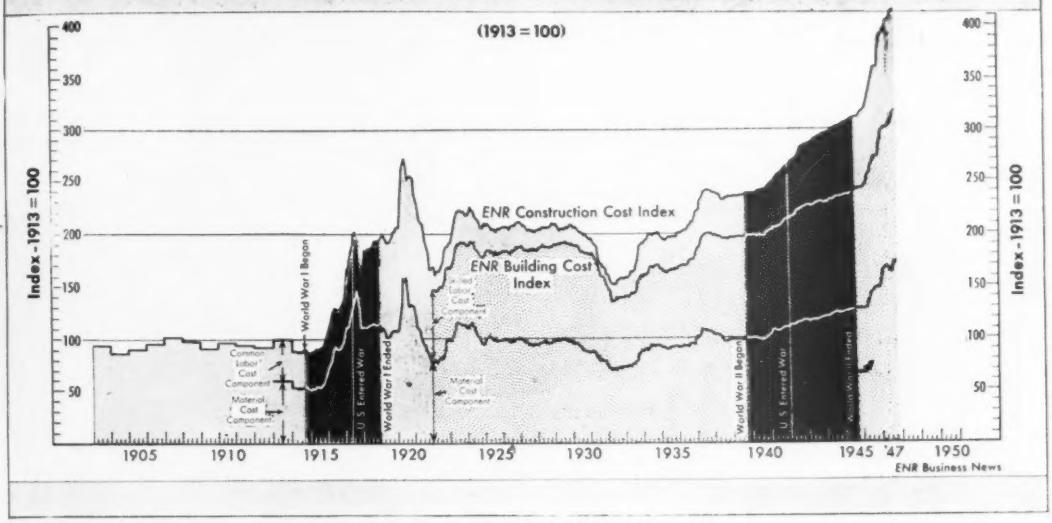
SEPTEMBER CONSTRUCTION BUSINESS REPORT

ENGINEERING NEWS–RECORD CONSTRUCTION AND BUILDING COST INDEX TRENDS



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	August 1946 (5 wk.)	August 1947 (4 wk.)	% Change †	Eight Months 1946 (35 wk.)	Eight Months 1947 (35 wk.)	% Change
Total U. S. Construction	$541,325	$413,494	−5	$3,685,841	$3,611,597	−2
Private Construction	339,100	232,772	−18	2,254,573	2,018,528	−10
Public Construction	202,225	180,722	+18	1,431,268	1,593,069	+11
Federal	41,234	44,398	+35	490,485	453,073	−8
E N R Construction Volume Index, 1913 = 100	258	215	−17	269	225	−16
Total New Productive Capital	320,066	1,163,187	+354	2,839,224	2,368,393	−17
Private Investment	145,252	96,747	−17	899,529	1,301,953	+45
Federal (non-federal work)	.....	247,711	.....	225,000	247,711	+10
Federal (federal work)	174,814	818,729	+485	1,714,695	818,729	−52

† *Adjusted for difference in the number of weeks reported.*

CONSTRUCTION COST . . . . WAGE RATES . . . . MATERIAL PRICE

1913 = 100	September 1946	September 1947	% Change	Change Aug. to Sept. 1946 Aug.	1946 Sept.	1946 %	1947 Aug.	1947 Sept.	1947 %
E N R Constr. Cost Index†	360.19	417.81	+16.00	361.37	360.19	−0.3	415.00	417.81	+0.68
E N R Building Cost Index†	272.37	317.08	+16.42	272.29	272.37	+0.03	313.03	317.08	+1.29

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$1.071	$1.221	+14.01	$1.070	$1.071	+0.09	$1.221	$1.221	0.0
Skilled Labor (Av. 3 Trades)	1.853	2.101	+13.38	1.831	1.853	+1.20	2.080	2.101	+1.01
Bricklayers	1.975	2.240	+13.42	1.961	1.975	+0.71	2.227	2.240	+0.58
Structural Ironworkers	1.860	2.124	+14.19	1.825	1.860	+1.92	2.078	2.124	+2.21
Carpenters	1.724	1.938	+12.41	1.706	1.724	+1.06	1.938	1.938	0.0
Cement, bulk, per barrel*	2.24	2.52	+12.50	2.24	2.24	0.0	2.41	2.52	+4.56
Structural Steel, base	2.35	2.80	+19.15	2.35	2.35	0.0	2.80	2.80	0.0
Sand, per ton	1.501	1.815	+20.92	1.499	1.501	+0.13	1.797	1.815	+1.00
Lumber, 2x4 Fir, per M ft.	69.947	89.98	+28.64	68.925	69.947	+1.48	88.05	89.98	+2.19
Lumber, 2x4 Pine, per M ft.	63.418	81.17	+27.99	67.181	63.418	−5.60	77.78	81.17	+4.36
Common brick, per M	22.055	23.512	+6.61	21.70	22.055	+6.64	23.175	23.512	+1.45
Ready-mixed concrete, c.y.	8.283	9.187	+10.91	8.242	8.283	+0.50	8.987	9.187	+2.23
Struct. clay tile, 3x12x12	98.232	118.06	+20.18	98.229	98.232	0.0	117.59	118.06	+0.40

* 18—*cities, average. Subject to revision.*

MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	August 1946	August 1947	% Change	July 1947	% Change July to August
Steel (% operating Capacity) A.I.S.I., weekly average	89.6	93.6	+4	86.0	+4

	June 1946	June 1947	% Change	Six Months 1946	Six Months 1947	% Change
Cement, thous. bbl. U.S.B. of Mines	14,564	18,179	+25	73,961	77,883	+5

	July 1946	July 1947	% Change	Seven Months 1946	Seven Months 1947	% Change
Fabricated Structural Steel, tons, A.I.S.C.	140,224	156,102	+11	788,089	1,034,931	+31
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	$213,468	$281,706	+32	$1,698,983	$1,564,487	−8

COST OF LIVNG INDEX . . . . EMPLOYMENT

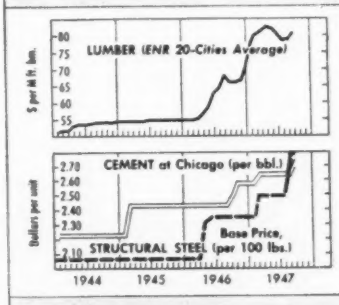
Base 1935–39 = 100	1941	June 1946	June 1947	% Change	May 1947	% Change May to June
Consumers' Price Index, B L S	105.2	133.3	157.1	+17.9	156.0	+0.7
Rent (Housing) Index, B L S	106.2	108.5	109.2	+0.6	109.2	0.0

	August 1946	August 1947	% Change	July 1947	% Change July to Aug.
Constr. Employment (est.), thous., B L S	2,300	2,239	−2.7	2,138	+4.7
Private Constr. Employ. (est.), thous., B L S	2,106	1,778	−15.6	1,698	+4.7

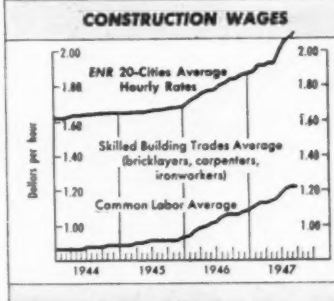
ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Sept., 1947	417.81	200.84	317.08	171.40	.....	.....
Aug., 1947	415.00	199.49	313.03	169.21	215	94
July, 1947	406.52	195.41	304.87	164.80	222	97
June, 1947	403.29	193.86	303.14	163.87	276	121
May, 1947	396.49	190.59	299.61	161.96	224	98
Apr., 1947	396.09	190.40	300.81	162.61	247	108
Mar., 1947	391.95	188.41	298.84	161.54	220	96
Feb., 1947	390.76	187.84	297.65	160.90	197	86
Jan., 1947	381.68	183.47	289.05	156.25	195	86
Dec., 1946	368.10	176.95	278.77	150.69	207	91
Nov., 1946	362.47	174.24	273.99	148.11	164	72
Oct., 1946	360.94	173.50	273.01	147.58	233	102
Sept., 1946	360.19	173.14	272.37	147.23	223	98
Aug., 1946	361.37	173.71	272.29	147.19	258	113
1946 (Av.)	345.94	166.29	262.25	141.76	248	109
1945 (Av.)	307.75	147.93	239.14	129.27	123	54
1944 (Av.)	298.72	143.59	234.73	126.89	96	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77

MATERIAL COST PRICES



CONSTRUCTION WAGES



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A smooth curb wastes the car's headlights. It reflects light away from the driver. Edge of road is difficult to see. Driving dangers are increased.

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White Concrete Reflecting Curb made with Atlas White Cement

Rain or shine, day or night, White Concrete Reflecting Curb made with Atlas White Cement clearly defines the highway's edge . . . increases visibility . . . adds to highway safety.

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"THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—ABC Network*

News of the Week

ENGINEERING NEWS-RECORD • SEPTEMBER 18, 1947 • VOLUME 139 • NUMBER 12

Congress group opens probe on housing shortage causes

First hearing reveals forecast of high production, complaints of poor workmanship, shortage of skilled labor as government officials testify for subcommittee

Mindful of the continuing severe housing shortage, and closely following a statement by the U. S. Veterans Administration that considerable poor work is being done on veterans housing, Congress has initiated what is expected to be an intensive investigation into housing. First step was an informal conference held in Washington last week, although formal hearings will start in October and members of Congress will probably hold hearings in areas outside of Washington where major shortages are reported.

The investigation is being carried out by a subcommittee representing the banking and currency committees of both the Senate and the House, aimed at evaluating the following: (1) the effect of existing legislation of state and local groups on the shortage and high cost of housing; (2) what can be done to decrease costs; (3) how building may be brought "up to date" to aid housing; (4) improvement of the financing of housing construction; (5) how slum clearance may be carried out most effectively and the part the federal government should play in this work; and (6) study of the effect the variation real estate taxation has on the housing shortage.

The September 10 conference with various federal officials revealed much new information as to present progress in relieving the nation-wide housing shortage.

Much housing started

The group was informed that a total of 750,000 housing units will probably be completed this year. This optimistic report was strengthened Sept. 16 when the Bureau of Labor Statistics reported that starts totaled 83,000 units in August, and completions for the same month totaled 69,500.

Veterans Administration representatives said that complaints are being received daily from disillusioned GI's who have purchased homes. Structural failures, deficient heating plants, wet cellars, unfinished landscaping and "a host of other matters too numerous to itemize" are cited as the result of poor construction. The agency is blaming both VA appraisers and lending institutions for failure to catch the defects during inspections of the houses while under construction.

Private appraisers

T. B. King, of the Division of Loan Guaranty of the VA, revealed that his agency has already loaned over $5 billion as 975,000 loans to veterans for purchasing both new and used housing. Private appraisers have been used to making estimates of the reasonable loan for most of this housing, and frequently a poor estimate was made. Those concerned are now being brought to task for their poor work.

H. E. Riley, chief of the construction statistics division, Department of Labor, told the committee that in August about 1,700,000 workers were employed at the site on new construction and that 590,000 of this total were at work on residential buildings. The total figure compares with a maximum of 2,400,000 workers in site construction during the peak of the war program. Despite this drop of employment in the industry, Mr. Riley said that there was no general labor shortage over a large area, but that there is a shortage in some areas of plasterers and lathers. He stated that there are now 49,000 plasterers in the entire U. S., as compared with 38,000 about five years ago.

Despite the increase of apprentices during the past year on construction, Department of Labor figures show that the average age of skilled construction workers is still increasing and that in some trades the average age is as high as 55 years.

Some materials still short

Several building materials continue to be in short supply, according to housing expediter Frank Creedon. The worst shortage is cast iron soil pipe, the lack of which is seriously delaying completion of homes in some areas.

(*Continued on page* 74)

Press Assn. photo

Probe Housing Shortage—*Sen. J. P. McCarthy of Wisconsin, right, questions a witness as a joint Senate-House committee opens an investigation into the nation's housing shortage. Listening are Chairman R. A. Gamble of New York, left, and Senator J. A. Sparkman of Alabama.*

NEWS IN BRIEF

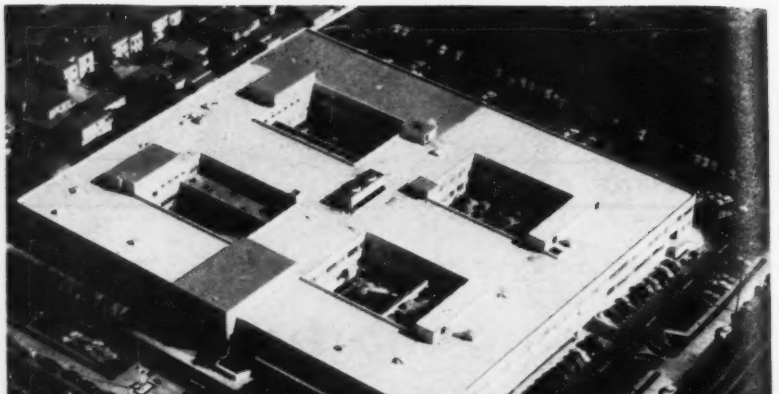
In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Highways—The *Pennsylvania* State Highway Department announced that municipalities have until January 1, 1948, to replace overhead traffic lights with the corner-post type, in compliance with a 1937 law requiring four lights on four street standards at busy intersections. . . . Under its postwar highway construction program, the *Iowa* State Highway Commission has let nearly $26,000,000 worth of contracts since October 30, 1945, including nearly $8,000,000 for work on farm-to-market roads. . . . The Ministry of Roads of the *Quebec* provincial government said that it has plans prepared for a $3,000,000 highway program for awards during the current fiscal year. . . . The *Pennsylvania* Department of Highways awarded a contract to Michael Baker, Jr., Inc., of Rochester, Pa., for complete surveys and design of 36 miles of four-lane divided highway on Route 22, to cost an estimated $9,000,000.

Construction—The Norfolk & Western Railway awarded a contract to John P. Pettyjohn & Co. of Lynchburg, Va., for an estimated $1,000,000 of work on the passenger station at *Roanoke, Va.* . . . Construction work on the *Toledo, Ohio*, Union Station will begin within two weeks, according to the Duffy Construction Corp., of Cleveland, contractors for the work. . . . A $1,000,000 mental hospital for women will be built by the Sisters of Charity near the city limits of *Louisville, Ky.* . . . Site for a $2,000,000 abrasives plant at *Vancouver, Wash.*, has been purchased by the Carborundum Co. of Niagara Falls, N. Y. . . . The Associated Spring Corp. has announced a $2,000,000 expansion program for its Wallace Barnes Division at *Bristol, Conn.*, to include a new manufacturing plant. . . . The Jones & Laughlin Steel Corp. of *Pittsburgh, Pa.*, has awarded to the Rust Engineering Co., of Pittsburgh, a contract for construction of a new $4,500,000 central boiler plant to serve the south side departments of the company's Pittsburgh Works.

Miscellany—The first postwar de luxe rental apartment house to be built on Park Avenue, in *New York City*, is now being erected by Sam Minskoff & Sons, owners and builders. The structure will be a 19-story and penthouse building, containing 95 apartment units for occupancy. . . . The California-Oregon Power Co. of *Medford, Ore.*, has awarded a $1,056,750 contract to L. E. Dixon, of San Gabriel, Calif., for construction of a 5,600-ft. tunnel as the first step in the $4,000,000 *Toketee* hydroelectric development.

Labor—The *Louisiana* State Highway Department has placed its employees on a five-day, 41-hour week. . . . An agreement covering working conditions of members of the International Union of Operating Engineers has been negotiated between the union and the National Constructors Association—a group engaged in refinery and steel plant construction—granting a closed shop for the ensuing year and uniform working conditions on work performed nationwide by members of the NCA. . . .A year-old contract between the Associated General Contractors and the AFL Buildings Trades Council at *Houston, Texas*, expired August 28 without renewal, and work is going forward without a contract. . . . Uncertainty about application of the Taft-Hartley act has stalled plans of the AFL building trades to organize the *Minnesota* construction industry on a statewide basis, according to F. J. Thill, president of the Minnesota Building and Construction Trades Council.



***Horizontal Skyscraper**—The term is contradictory, but Rexall Drug Co. executives insist that their new office at Los Angeles, Calif., is a skyscraper on the ground. The building, providing main offices for the company and space for its largest store in the northeast corner, is a two-story, steel frame structure, 325 x 400 ft. in plan, air conditioned, with an exterior finish of concrete. Interior courts provide recreation and dining areas for employees. Set back from the street, the location provides off-street parking for some 300 cars.*

Abolish grade crossings for Schuylkill bridge

To permit the Pennsylvania State Highway Department to start work on a proposed $10,000,000 bridge carrying the Penrose Ferry road over the Schuylkill River in Philadelphia, the Public Utility Commission has taken initial action to abolish existing grade crossings.

The proposals concerned the elimination of grade crossings where industrial sidings cross Penrose Ferry road, part of the industrial highway linking Philadelphia and Chester, Pa.

Noting that the present drawbridge carrying Penrose Ferry road over the Schuylkill has been closed on account of "accidental failure," the commission said "A preliminary order temporarily approving the construction" should be issued "to permit the necessary construction to be started."

To study waterways of Massachusetts

Governor Robert E. Bradford of Massachusetts has signed a legislative bill creating a special unpaid commission to study the inland waterways of the state, with particular reference to flood control, power development, pollution control, and opening the Connecticut River to navigation from Hartford to Holyoke.

Continue debate over new Bay crossing

While officials of the California Public Works Department said they were ready to make detail studies and designs for a second San Francisco-Oakland Bay crossing, citizens of the area surrounding the bay continued a long-standing controversy over the type and location of the new crossing.

A joint Army-Navy board recently submitted to Congress (*ENR*, Sept. 4, vol.p. 303) a complicated plan involving a causeway-trestle-tube crossing in the southern part of the bay; while the California Toll Bridge Authority early in the year had made preliminary studies for a crossing recommending a bridge similar in design and closely paralleling the present span (*ENR* Feb. 27, vol.p. 345).

Charles H. Purcell, California director of public works, last week declined comment on the Army-Navy report on the ground that he had not had time to study it, but said that his department will begin studies on Sept. 24, preparatory to making detail designs for a second crossing. Funds for the work—some $935,000 appropriated by the last legislature—will become available on that date.

Mr. Purcell points out that the Toll Bridge Authority is the only agency regularly empowered to build the crossing, and that his department constitutes the engineering staff for the Authority.

In the meantime, various citizen groups not in sympathy with either the Authority plan or the Army-Navy suggestion were preparing to take their own ideas to Governor Earl Warren, considered by many as the key man in the determination of the type and location of the new crossing.

One group, representing all counties surrounding the bay, will soon make recommendations to the governor offering a compromise between the Authority's plan and the Army-Navy proposal.

Favor joint board

The San Francisco board of supervisors in an informal poll indicated that they would approve a resolution asking the governor to appoint a state-federal board to give further study to the subject. This board would be patterned after the Hoover-Young commission which was set up in 1929 to review the general problem of a bay bridge and formulate a method of procedure (*ENR*, March 22, 1934, vol.p. 372).

Citizens of the area who have supported the Reber plan (*ENR*, July 11, 1946, vol.p. 56) as a means of carrying traffic across the bay, are also expected to appeal to the governor for support.

TACOMA BRIDGE INSURANCE

Because of the enormous size of the policy and the risk involved, between 50 and 100 insurance companies are expected to divide insurance on the new Tacoma Narrows suspension bridge. Construction bids are due Oct. 15.

The Washington State Toll Bridge Authority has named three brokers to arrange for the insurance, estimated to total between $9,000,000 and $10,000,000. The exact amount necessary will not be known until the opening of construction bids.

George W. Farnsworth of Seattle, one of the brokers, declared that a majority of the insurance companies of the world will be necessary to write the policies. He pointed out that bridges as a class are considered hazardous.

Insurance on bridges usually is taken out on completion of a span, but the Narrows bridge will be insured as soon as construction begins, to reassure prospective bond buyers.

$84 million military building in Alaska

The Territory of Alaska is experiencing what observers say is an unprecedented peacetime military construction program this year, under an Army-Navy plan primarily devoted to making some of the war built bases permanent. Total expenditures by the two services are expected to reach $83,000,000 on present contracts, employing more than 9,000,000 civilian workers.

During the war, military installations were rushed into construction from Annette Island to Attu and Shemya, in an engineering offensive that saw the expenditure of nearly a billion dollars by the Army and Navy.

The current $64,000,000 Army construction and the $18,000,000 Navy construction programs are pointed toward making some of the Northern bases permanent and habitable for service and civilian personnel and their families.

Both Army and Navy have been shifting and consolidating to meet reduced peacetime budgets. The Army now handles mainland construction and the Navy directs work on the Aleutian chain. The Army is withdrawing from Amchitka, Attu, Shemya and Kiska; and with Kodiak on a caretaker basis, the Navy is reducing its installation at Attu and withdrawing from Dutch Harbor. In general, the joint program embraces repairs, construction of some port facilities, covers storage facilities, air facilities and housing of family type.

Prime Navy contract at present, for $13,837,000, is held by Drake-Puget Sound Construction Co. of Seattle, for projects at Adak and Attu on a cost-plus-fixed-fee basis. The firm is a joint venture of Puget Sound Bridge & Dredging Co. of Seattle, and Johnson, Drake & Piper organization of Des Moines, Iowa.

Army construction calls for major construction at Whittier, Fort Richardson, Ladd Field and Mile 26 (southeast of Fairbanks). Prime contractor is Birch-Johnson-Lytle Construction Co., Seattle, with about $58,000,000 in present cost-plus-fixed-fee assignments, and architect-engineer services for design of all facilities are performed by Fay, Spofford & Thorndike of Boston on a contract for about $2,000,000.

Navy armory program totals $40,000,000

A $40,000,000 program calling for the construction of 310 Naval armories scattered throughout the United States for the training of reserves is now underway. The work calls for the alteration of existing naval facilities for about 130 of the armories and new construction for the remaining 180.

The program is part of a plan to train a total naval reserve of 750,000 officers and men. Although the Navy has been handicapped by the shortage of labor and materials, the award of construction contracts is now nearing the halfway point in the number of contracts let. To date 80 competitive lump-sum contracts have been awarded for quonset hut projects, or for about 45 percent of the 180 new buildings contemplated. About 60 of the conversion jobs have also been awarded.

The typical new armory or training center will consist of three quonset huts set parallel and connected across the front by a conventional rectangular structure for offices. In the other space machine shops, carpenter shops, class rooms and other work areas will be available. Each center will contain facilities for the training of from one to three naval reserve divisions.

Work is also proceeding at 120 mooring sites where reserves are making use of naval aircraft in connection with the training activities.

Construction is being supervised by the Bureau of Yards and Docks.

Lack of chlorine shuts Los Angeles beaches

State re-imposes ban when chlorination stops at Hyperion—W. Va. pushes abatement work

A shortage of California chlorine stocks due to overtaxed hydroelectric power supply resulted two weeks ago in a cessation of chlorination at the Hyperion sewage disposal plant in Los Angeles county and caused re-enforcement of a recently-lifted quarantine on nearby beaches.

The California Board of Public Health, which recently released some 4½ miles of a 12-mile strip of beach from quarantine when chlorination of sewage at the Hyperion outfall proved successful in decreasing pollution (*ENR*, August 14, vol. p. 225) re-imposed its ban.

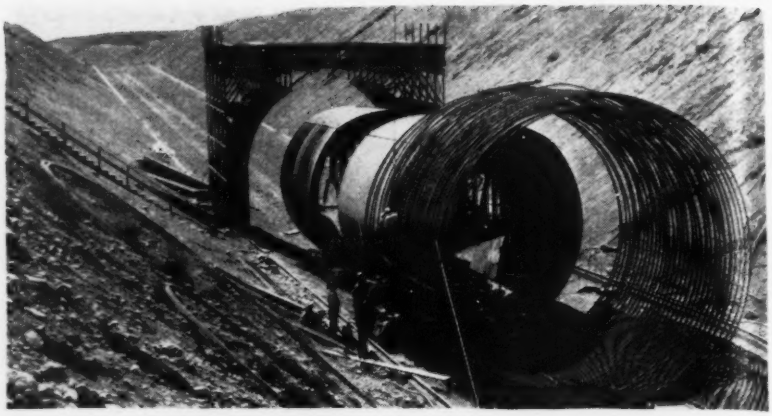
A two-thirds cut in "dump" power supplied to Dow Chemical Co. at Pittsburg, Calif., by the Pacific Gas & Electric Co., caused a corresponding cut in output of the company, principal supplier of chlorine for California and neighboring Southwest states.

Subnormal rainfall in the state, combined with an unprecedented demand for industrial and agricultural power, forced PG&E to cut energy furnished to Dow and two other chemical companies under a special surplus power contract. PG&E officials said that the power threat to chemical companies was expected to be short-lived, since the company is expecting a normal drop-off in the demand for agricultural water. Additionally, an extensive construction program, now under way, is expected to provide against future shortages.

West Virginia pushes work

West Virginia reported last week that work is going ahead rapidly throughout the state, with both municipalities and industry making big advances. The report from the State Health Department indicated that domestic pollution treatment plants are now under construction in six cities; while on the drafting board or in advance planning stages are plans for thirteen plants.

K. S. Watson, engineer of the West Virginia State Water Commission, also reported that private industrial firms building new plants covering treatment facilities include: E. I. du Pont de Nemours, at Parkersburg; American Cyanamid Co., Willow Island; Wheeling Machine Products, Elm Grove; Virginian Woolen Co., Middleway; Southern Maid Dairy, Union; and Monongahela Power Co., Willow Island.



***Large Movable Forms**—These movable forms, largest of the type ever used in the Pacific Northwest have been assembled on the Bureau of Reclamation's Columbia Basin Project in eastern Washington to speed building of a 25-ft. siphon to carry irrigation water. Costing $57,000, the device operates by using two telescoping inside forms and an outside clamp. Concrete is poured between inside and outside forms and strengthened with reinforcing steel hoops. Forms are withdrawn and reused when concrete has hardened. Large quantities of castor oil, mixed with kerosene, are applied to prevent concrete from adhering to steel forms. Apparatus is owned by Winston Brothers and Utah Construction Co. who hold a $4,000,000 "West Canal" contract on which the forms are employed.*

43 enter designs for Jefferson memorial

Only 43 entries in a national competition for $125,000 in prizes for a design of the proposed Jefferson National Memorial at St. Louis, Mo., were received prior to closing time the night of Sept. 2, Julian C. Spotts, memorial superintendent, said last week.

More than 200 architects and engineers had signified their intention of submitting designs, Spotts said, adding that it is possible that other entries may still come through, since they would be eligible if postmarked before the deadline.

The proposed $39,000,000 memorial, commemorating the Louisiana Purchase, would be located on a river bank area already cleared of buildings between the Eads and the Douglas MacArthur bridges. Five of the entries will be selected for the final stage of the contest, and authors of the five designs will be requested to submit more detailed plans. For winning the initial step, each author will receive $10,000. The final winner will receive $40,000, and will be recommended to the Department of the Interior for selection to execute his plan for the memorial.

Judging of the entries by a committee of seven architects will begin about mid-September, Mr. Spotts said.

SCENIC ROAD AROUND VOLCANO

A scenic road soon will be completed around the crater of the world's largest dormant volcano, 10,000-ft. high Haleakala on the island of Maui, Hawaii.

Construction of the final segment of the 21-mile summit loop will be under way by Nov. 1, Robert M. Belt, Hawaii superintendent of public works said. The scenic road will be completed with prison labor, in accordance with the directive of the 1947 territorial legislature.

Territorial Governor Ingram M. Stainback also favors construction of a road to the summit of Mauna Lau, 13,675-ft. active volcano on the adjoining island of Hawaii. The legislature, however, appropriated no funds for the Mauna Lau project.

Engineers start work on Whitney Dam project

Construction work on the $31,000,000 Whitney Dam on the Brazos River, Tex., was started recently.

Located about 38 miles northwest of Waco and about 19 miles southwest of Hillsboro, the project will include a reservoir covering more than 2,000,000 acres, and a dam and embankment 14,450 ft. long. The concrete spillway will be 824 ft. long and a power house of 60,000 kw. is planned.

HIGHLIGHTS OF MUNICIPAL DEVELOPMENTS

Urge establishment of engineering division for Baltimore—Omaha bridge to be toll-free this month—Street repair projects under consideration—sewer bids exceed available funds

In view of a city construction program now totalling more than $38,000,000, Mayor Thomas D'Alesandro of Baltimore, Md., last week urged the formation of an engineering and architectural division within the city government in order to save "considerable sums" on engineering and architectural fees.

Mr. D'Alesandro pointed out to the city's Board of Estimate that voters have now approved some $38,000,000 worth of bonds for public improvements—including $20,000,000 for school construction—and declared that the money now available would make it possible to hire engineers and architects for periods of several years.

Agreeing that it would be feasible to assemble staffs for "normal-sized" jobs, Nathan L. Smith, director of public works, declared that in jobs of unusual size it is much better for the city to engage outside help. He also pointed out that the 25 or 30 men who would be needed for such a division are not available, since private industry wage scales are higher than those paid by the city at present.

Subsequently, however, the estimate board approved wage boosts for a number of city engineering employees, involving salary increases ranging up to $2,000. Under the new scale, an associate engineer was raised from $4,715 to $6,700; a junior associate, from $3,970 to $5,200; senior civil engineers from $3,400 to $4,800; survey inspectors and chief of survey party, from wages of $2,640 and $3,080 to $3,800; and engineering aids from a range of $1,610 to $1,690 to a new range of from $2,500 and $3,000 annually.

Bridge tolls off

After 59 years of existence as a toll bridge, the Ak-Sar-Ben Bridge across the Missouri River between Omaha, Neb., and Council Bluffs, Iowa, will become a free bridge Sept. 25.

Freeing of the bridge—which will make it the first free bridge between the two states and has already increased property valuations on adjoining land—is the result of eight years of effort by Ak-Sar-Ben, a unique statewide public improvement association, which purchased the structure from the Omaha and Council Bluffs Street Railway Co. in 1938 with the express purpose of making the bridge free.

The last payment of the $2,350,000 indebtedness on the structure was made by the association last week, and shortly after ceremonies on Sept. 25, the bridge will be turned over to Nebraska and Iowa highway department officials for maintenance.

Street, traffic problems

Still facing the problems of congestion and the need for repairing heavily-travelled city streets, city officials last week wrestled with proposed solutions.

At Boston, Mass., the city awarded a $107,000 contract to Charles A. Maguire Associates, Providence, R. I., consulting engineers, for a traffic survey of conditions within the metropolitan area. At Baltimore, Md., a civic group sharply criticized the slowness of street repair work.

The St. Louis, Mo., City Planning Commission approved a plan for construction of a $6,366,000 superhighway along Third Street, as an elevated roadway to carry four lanes of traffic. At Detroit, Mich., the City Plan Commission made formal reports expressing its preference for depressed highways over limited-access parkways because of greater access and fluidity to meet city traffic needs; and at Wilmington, Del., street department directors tentatively approved parking and traffic-regulation changes that would create express streets, and one-way streets.

Airport disapproved

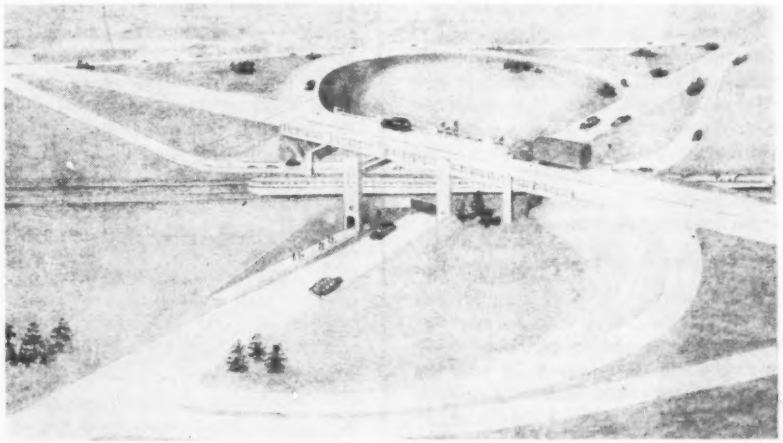
The Minneapolis, Minn., Planning Commission last week had issued a report favoring the abandonment of the Wold-Chamberlain airport, in south Minneapolis, for a new rural airport to be located to the north of the Twin-City area in Anoka County.

Charleston, S. C., meanwhile, completed plans for a $350,000 administration building at its municipal airport, to house five major airlines, field administrative offices, Weather Bureau offices, and other facilities.

Sewer cost too high

Omaha, Neb., city officials said last week they will probably abandon for a time plans to construct a trunk-line sewer in South Omaha, near the city's famous stockyards, after bids received for the work proved to be higher than the entire amount of a bond issue subscribed for the project.

Low bid was $2,403,453, while the bond issues was for $2,090,000. Contractors said that heavy sand in the area would cause increased expenses.



***Triple-Decker**—To accommodate the intersection of Routes 13 and 460 and the double-track main line of the Norfolk and Western R. R., the Virginia Department of Highways is now building a triple-deck traffic interchange near Norfolk. Eliminating a serious bottleneck, the structure will carry Route 13 on the top level; the railroad and a connecting road on the center level, and Route 460 at the bottom. The E. W. Grannis Co., and Lewis and Bowman Co., Fayetteville, N. C., are contractors on the $955,522 structure, under supervision of E. D. Hubbard, resident and engineer.*

Congress group opens housing probe

(*Continued from page 69*)

Other materials still critical are: gypsum products, plumbing fixtures, plywood, millwork, nails, iron and steel pipe fittings, hardwood flooring, and sheet metal products.

The price of building materials also continues high, Mr. Riley told the committee. He said that the Department of Labor's Building Materials Index, which takes into account the cost of over 100 materials, as of July this year stood at 176.5. This figure, which is the latest available, compares with the base figure of 100 for 1926. The Index pertains only to wholesale price quotations. Lumber remains especially high priced.

No big cost drop expected

It was the general opinion of the conference that the cost of housing construction is going to be reduced gradually and not drastically in the next few years. The lowering of costs will come through several actions, rather than from one major factor, it was pointed out.

One of the factors that is expected to reduce costs is improvement of building codes and the adoption of entirely new codes by some municipalities.

George N. Thompson, assistant chief of the new Division of Building Technology at the National Bureau of Standards, revealed that of U.S. cities of over 2,500 population, only 2,000 have regulations that could be classed as building codes.

A survey in 1940 showed that only 17 states have enabling legislation clearly permitting municipalities to adopt new codes by reference, that is, without the need of going to the great expense of printing the building codes referred to, J. Marshall Mayes, of the Construction Practices Division, Department of Commerce, told the committee.

New materials create problem

The slowness with which cities can accept the use of new materials was also seen as a major factor delaying housing work. Mr. Thompson, who has played an important part in making a pilot study of codes, including a study of a sample of 100 codes, summarized this problem as follows: "The problem of dealing with new types of construction and new materials has not been neglected. I think our findings indicate that about 80 percent of this sample contained some specific provision for dealing with new types of construction. The difficulty comes in how the building official exercises the discretion that is conferred on him by the code.

"The first thing he runs up against in exercising that discretion is that there isn't any standard method of testing that material, in a number of instances. So one fundamental thing that needs to be done is to develop standard methods of testing, particularly for prefabricated types of construction."

When queried about the long-range need for housing, Administrator Foley said that the National Housing Agency in 1944 found the need totaled 1,260,000 housing units yearly for 10 years. The same year a senate subcommittee, after an extensive investigation, placed the need at 1,500,000 units yearly. Although no detailed study had been made to bring an estimate of the total need up to date, Administrator Foley believes that the demand today is as great as in 1944.

The Bureau of the Census is soon to complete a sample survey of the housing demand conducted in April of this year, which will provide up to date figures.

Few amusement projects ok'd by U. S. agencies

Few projects calling for the construction of facilities for amusement purposes are being approved by the office of Housing Expediter Frank R. Creedon, who now is in charge of the few remaining controls on construction. Between July 1 and early September only 318 amusement projects to cost less than $9,000,000 have been approved.

In accordance with the rent control law passed during the last session of Congress most controls on building disappeared July 1 (*ENR* June 26, vol. p. 987). However, this bill left in place restrictions on the construction of theaters, racetracks and other amusement projects.

In the two months since July 1 about 800 projects have been rejected with the aim of saving the necessary materials for housing and other work considered more desirable at this time. During recent weeks an increasing number of theaters have been approved, but during the last week of August denials of all types totaled 66 jobs.

PERSPECTIVE . . . .

Housing Boom Appears

Housing construction for the year 1947 — somewhat unexpectedly — will approach the huge totals of the boom years of 1922-'28, it appeared last week as starts for September continued a three-months-old contra-seasonal upswing.

A combination of circumstances—most important being continued high demand, general availability of materials, plentiful mortgage money and abolition of federal controls—has kept the indicator of housing starts moving upward until informed Washington opinion now estimates that total units completed will reach or top the 800,000 mark.

The nation's biggest recorded housing production years were from 1922 to 1928, when the construction industry turned out more than 800,000 units a year, reaching a top of more than 900,000 in 1925.

The incipient boom appeared in June of this year, when 77,200 starts and 63,000 completions were reported by the government's Bureau of Labor Statistics. In July, the figure rose to 80,000 starts and 65,000 completions; in August to 83,000 starts and 70,300 completions, and the September starts will probably total over 74,000.

This trend is completely contra-seasonal, and, more importantly, is contrary to the predictions of some governmental pessimists who had been predicting a sharp drop at the end of August, because of lack of building materials.

The material supply situation, accurately forecast by this journal seven months ago (*ENR* Feb. 20, vol. p. 298) is generally good, excepting for some spot shortages (such as nails in the east).

One reason for the easing in supplies is that non-residential building is rather lower than expected. Washington experts now expect housing to total more than $4,500,000,000, but non-residential construction estimates have been scaled down somewhat, to hold the over-all construction value estimates at about $12,200,000,000.

There is little indication as yet of any decided shift into rental housing. Most of the gains seem to be recorded in suburban and small-town areas, suggesting single-family owner-occupancy.

Urge further rise in apprentice ranks

During the year Aug. 1, 1946, to Aug. 1, 1947, the number of apprentice workers being trained for the construction industry under registered programs in cooperation with the Department of Labor increased nearly four fold—from 26,000 to 103,643—W. F. Patterson, director of the department's apprentice training division said last week.

Addressing the Washington, D. C. Building Congress, he said that this was far from enough and that a great increase in the number of men being trained must be an important factor in bringing down construction costs.

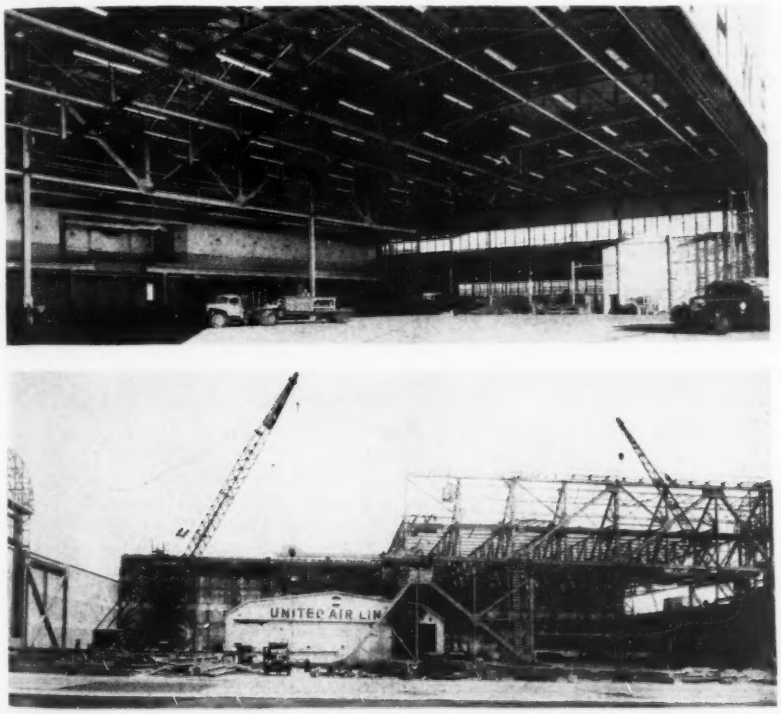
"About 52,000 employers, now participating in the program, but this number should be increased to 190,000 contractors," Mr. Patterson said. "For example, only about one-half of the apprentice painters needed are now being trained."

The 103,643 apprentices taking part in the program as of Aug. 1 are listed as follows: Trowel trades, 13,574; woodworking, 37,244; painting trades, 8,610; pipe trades, 15,582; electrical, 15,787; sheet metal, 8,297; and miscellaneous, 4,549.

To expand the apprentice plan and to provide maximum aid to the construction industry, Mr. Patterson outlined seven major steps that should be taken to procure facts on the construction industry as a whole as on each of the individual trades. In this work, local construction groups should play an important part, he said.

The steps should be as follows:

(1) Calculation of the number of skilled men in the trades; (2) determination of the average or median age of the skilled workers of each trade; (3) evaluation of the rate of loss or attrition of skilled workers to the industry; (4) determination of the number of apprentices in training or entering training; (5) an estimate of the volume of construction anticipated over a period of years; (6) conversion of the construction estimate into the number of skilled workers needed, and (7) the determination of the number of apprentices needed to fill the ranks of each trade.



***Hangars**—Two new airline hangars—one (top) at Seattle, and the other at Chicago, show newest approaches to the problem of providing clear floor space over large areas. The Seattle hangar, built by The Austin Co. for Northwest Airlines, utilizes nine cantilever-type trusses to give the building an almost completely unobstructed floor (only two columns are used) 110 ft. deep by 226 ft. wide. The cantilevered arms are connected to 50 ft. anchor arms along three jack trusses. The Chicago hangar, also an Austin Co. job, is 120 ft. deep, 65 ft. high and 275 ft. wide, to accommodate planes of United Air Lines. The roof structure, of jack-truss type, was fabricated on the ground and hoisted into place.*

"Engineered House" seen solving cost problems

Principles for reducing the cost of houses have been developed as a result of the industry-engineered homes program, according to the National Retail Lumber Dealers' Association and the Producers' Council, initial sponsors of the project.

The program is directed toward making available to small-scale builders the most efficient construction methods while permitting use of materials and plans coordinated to produce a substantial reduction of cutting, fitting and waste.

Basic principles evolved to date, suggested as being applicable to any small home design, include:

(1) Modular design, coordinating materials using a 4-in. multiple; (2) adoption of a 4-ft. planning multiple for lengths, widths and heights of rooms or interiors; (3) use of 16-ft. unsupported span where possible (based on maximum span of 2 x 10 in. joists); (4) application of finished floor and ceiling materials where feasible, before erection of interior partitions; (5) use of precut, preassembled materials (particularly in closet and storage walls, partitions and roof trusses); (6) use of a plumbing wall, or shortest plumbing and heating lines for proper functioning; (7) use of basic home designs subject to easy change of appearance through positioning on the lot, minor additions and decorative treatment.

Two plans developed

To illustrate the application of these principles, two house plans have been developed. One is L-shaped and made up of two 16 x 24 ft. units set perpendicular, providing kitchen, bathroom, living-dining room, two bedrooms and six closets in an area of 768 sq ft., with studs and rafters spaced at 24 in. and floor joists at 16 in. The second plan calls for a two-story structure, composed of a 16 x 28 ft. unit placed on top of a similar unit, and is said to be the most economical type for the floor space provided. Rafter and ceiling joists are 24 in., center-to-center, studs and floor joists 16 in.

ENGINEERING SCHOOL NEWS

Comparative study of radiant and convector heating at Georgia Tech—Institute of numerical analysis at UCLA—Smaller building construction course at University of Tennessee

A comparative study of the difference between radiant- and convector-heating systems in a multi-story building will be undertaken this fall by Georgia School of Technology upon completion of its 8-story student apartment building. H-shape in plan, the structure is of reinforced concrete and brick and contains about 63,000 sq. ft. of floor space. One wing will be heated with conventional type convectors, while the other will be radiant-heated, using wrought-iron pipe placed at the center of the 5-in. thick concrete floor slabs. A solid 12-in. hollow-tile bulkhead in the center of the H separates the wings. All floors are identical and the 8 floors are tied in with the same risers. This allows for tests of the entire building, or for any tier of identical apartments, but not for individual floors or individual apartments.

Hot water is provided by means of two converters, one for each type of heating system, on the school's central steam supply lines. The converter for the radiant-heating system is set at 120 deg. to 140 deg. F. and the converter for the convector heating lines at 180 deg. to 200 deg. F. Both converters are 5,000 gal. per hr. and steam pressure is 25 lb. Separate outdoor anticipating-type thermostatic arrangements are used to control each system.

Construction of the building and installation of the heating coils illustrate the need of coordination between design of reinforcing steel and coil design. It was necessary to thread the heating coils through the reinforcing bars, which resulted in excessive labor costs. Shop-fabricated coils had to be cut, threaded through the bent reinforcing bars and then rewelded.

Engineers recommend that on future jobs steel design should call for two layers of reinforcing with no bent bars to allow almost complete shop fabrication of the heating coils. The method of construction would be to lay one layer of steel, then the heating coils and a top layer of steel.

Tests on the system will be conducted under the direction of H. W. Mason, professor of mechanical engineering, and W. A. Hinton, associate professor of mechanical engineering. In testing, heat quantities will be obtained for each half of the building by measuring the condensate from the converters. Equal conditions of comfort will be established for each section.

The building was designed by Stevens & Wilkinson, Atlanta architects and engineers, and is being erected by the J. A. Jones Construction Co. Plumbing and heating contractor is O'Pry Heating & Plumbing Co., Atlanta, and the radiant heating pipe coils were shop-fabricated by Williams Brothers Corp., Chamblee, Ga.

An Institute of Numerical Analysis is to be established at the University of California in Los Angeles to do research in applied mathematics and provide a high-speed computing service for the West, according to an announcement by Clarence A. Dykstra, university provost, and Edward U. Condon, director of the National Bureau of Standards, Washington, D. C.

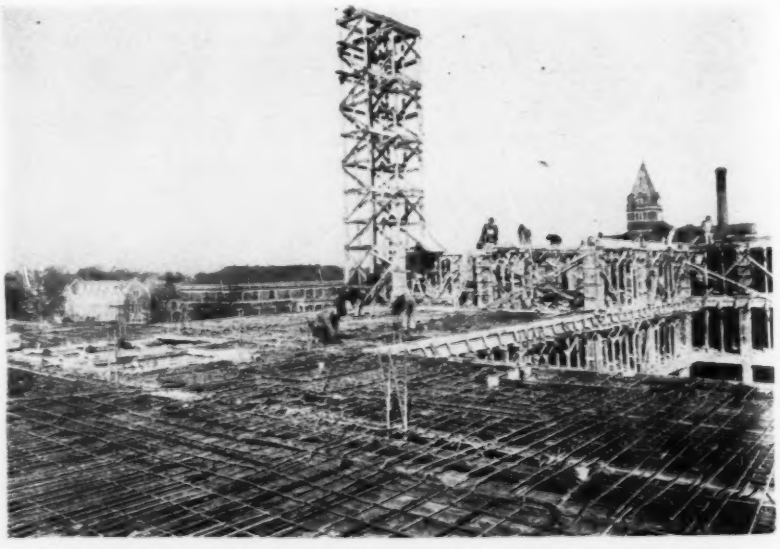
Temporary quarters for the institute will be set up by Nov. 1, and a permanent space will be provided in the new engineering building being constructed on the campus.

The institute will be a unit of the National Applied Mathematics Laboratories now being organized at the Bureau of Standards. It will have two basic functions: (1) research and training in applied mathematics with particular emphasis on the efficient exploitation and development of high-speed electronic computing machines, and (2) the provision of an expert computing service for groups located in the West to assist in the formulation and analysis of difficult problems in applied mathematics.

The University of Tennessee, which already offers a course of training in heavy construction, this fall will add a course in the building of homes, farm buildings, stores, garages, small industrial buildings, and structural repairs.

Fifteen new instructors in the staff of University of California Engineering Extension in the Los Angeles area bring the total of extension instructors to 55. Newcomers are: Lloyd Polentz, Robert K. Strugess, Morris Asimow, Peter A. Boukidis, F. A. Wright, M. Neustadt, D. Rosenthal, Thomas T. Taylor, R. Bromberg, John W. Mathewson, Mitchell Gilbert, Joseph A. Burgard, Lester Morris, Thomas D. MacGregor, and Laurence G. Borgeson.

The Canadian Army is maintaining the former A-6 Canadian Engineer Training Center at Chilliwack, B. C., as the newly established Royal Canadian School of Military Engineering. It is on a 700-acre tract at the junction of the Vedder and Chilliwack rivers in the Fraser Valley. Training rights have been obtained from the province in 300 sq. mi. of the Chilliwack River valley.



***Heating Experiments**—Radiant-heating installation in one wing of an apartment building at Georgia Tech., Atlanta, Ga. Convector will be used in the other wing of the building.*

OBITUARY

Thomas Bower, 55, a civil engineer who served as an UNRRA official and was at one time director of general finance for the Persian government, died Sept. 3 at Columbus, Ohio. He was a 1916 graduate of Ohio State University, in civil engineering, and traveled extensively in India, China and Japan, as well as many countries in the Near East.

John S. Barlow, 65, a consulting engineer of Dallas, Texas, died there recently. One of the engineers on the development of the Naval Air Station at Corpus Christi, Texas, he was from 1935 to 1940 an engineer for the Federal Works Agency and the Public Works Administration.

Thomas H. Kilner, 79, a general contractor in Toronto, Ont. since 1908, died Sept. 3.

Louis Y. Dawson, 77, for almost 50 years chief engineer for the South Carolina Power Co., and founder and former president of the Dawson Engineering Co., died at Charleston, S. C., Sept. 8. He had retired from the service of the power company in 1946.

Henry G. Bradlee, 76, former vice president of Stone & Webster, Inc., died at Brookline, Mass., Sept. 3. A graduate of Massachusetts Institute of Technology, he joined the Boston engineering firm in 1891.

Richard W. Chapman, 40, a consulting engineer for Hardy & Son of New York, died Sept. 9 at Yonkers, N. Y. A graduate of Dartmouth College, he served as an engineer with the International Paper Co. before joining the New York firm in 1937.

George E. Wilson, 73, president of the Clinton Bridge & Iron Works, the General Engineering company, and George E. Wilson, Jr. Company of Clinton, Iowa, died recently.

Thompson F. Taylor, 48, deputy county engineer of Champaign County, Ohio, for the last several years, died recently at Urbana, Ohio. He was a graduate of Ohio State University in civil engineering.

Morton Milne Gibson, a civil engineering graduate of Toronto University, and for the last ten years engaged in highway work for the Ontario Department of Highways, died Sept. 9.

Harry L. Parker, 71, retired civil engineer and former Buncombe County, N. C., commissioner of public works, died at Asheville, N. C., Sept. 9. A native of Hillsboro, Ohio, he was long concerned with the development of Asheville, and for a time served with the city's engineering department on expansion of the water system.

Business men discuss urban planning problems

In a two-day series of panel discussions attended by many engineering officials, U. S. businessmen last week heard and took part in discussions seeking to focus attention of the business community on urban planning problems, including relief of traffic congestion, slum clearance and other engineering matters.

The meetings were sponsored by the U. S. Chamber of Commerce, and held in the chamber's headquarters at Washington, D. C.

First-day sessions were devoted to discussions of city planning in relation to community development, and included detailed reports on the functions and effects of organized city planning commissions, zoning ordinances, and similar matters.

MAJOR MEETINGS

Building Officials Conference of America, Inc., joint annual meeting with Building Officials Foundation, Deshler-Wallick Hotel, Columbus, Ohio, Sept. 22-25.

American Association of State Highway Officials, 3rd annual meeting, Waldorf-Astoria Hotel, New York City, Sept. 22-26.

Associated General Contractors of America, Inc., fall meeting, Savery Hotel, Des Moines, Iowa, Sept. 28-Oct. 1.

The Producers' Council, annual meeting, Hotel Commodore, New York, N. Y., Oct. 1-3.

Institute of Traffic Engineers, 18th annual meeting, Hotel Fort Shelby, Detroit, Mich., Oct. 1-4.

American Public Works Association annual Public Works Congress, Hotel George Washington, Jacksonville, Fla., Oct. 5-8.

National Safety Council, annual convention, Stevens Hotel, Chicago, Ill., Oct. 6-10.

American Society of Civil Engineers, fall meeting, Roosevelt Hotel, Jacksonville, Fla., Oct. 13-17.

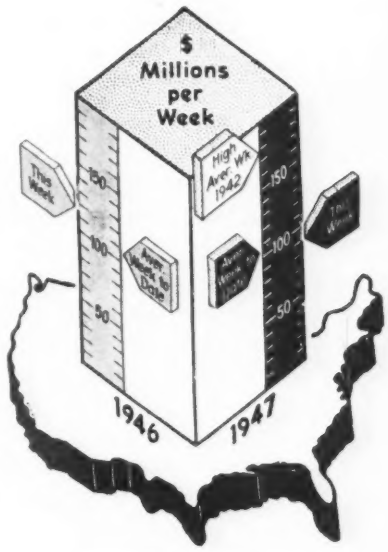
National Metal Congress and Exposition, Palmer House, Chicago, Ill., Oct. 18-19.

American Welding Society, annual meeting, Sherman Hotel, Chicago, Ill., Oct. 20-24.

Engineers' Council for Professional Development, 15th annual meeting, Mount Royal Hotel, Montreal, Canada, Oct. 24-25.

National Council of State Board of Engineering Examiners, 26th annual meeting, Hotel Pennsylvania, New York, N. Y., Oct. 27-29.

CONSTRUCTION ACTIVITY



As Reported this week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Sept. 18 1947	Cumulative 1947 (38 wks)	Cumulative 1946 (38 wks)
Federal	$11,180	$484,838	$495,914
State & Mun.	33,550	1,249,173	1,028,721
Total Public	$44,730	$1,734,011	$1,524,635
Total Private	45,897	2,237,208	2,450,188
U. S. Total	**$90,627**	**$3,971,219**	**$3,974,823**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (38 wks)	Cumulative 1946 (38 wks)
Waterworks	$983	$80,096	$74,757
Sewerage	4,421	98,625	73,031
Bridges	3,832	125,048	101,466
Highways	12,769	595,811	589,325
Earthwork, Waterways	8,971	225,838	268,687
Buildings, Public	10,708	415,485	288,475
Industrial	10,274	610,921	787,904
Commercial	27,878	1,306,982	1,503,844
Unclassified	10,791	512,413	287,334

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial building, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (38 wks)	Cumulative 1946 (38 wks)
NON-FEDERAL	$1,651,116	$1,167,164
Corporate Securities	594,742	348,638
State and Municipal	808,663	593,526
Fed. Aid Highway	247,711	225,000
FEDERAL	818,729	1,714,695
Total Capital	**$2,469,845**	**$2,881,859**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Sept. '47	417.81	200.84
Building Cost	Sept. '47	317.08	171.40
Volume	Aug. '47	215	94

EDITORIALS

VOLUME 139 NUMBER 12

September 18, 1947

Make the Most of It!

THE MANNER in which public support is activated in matters that are highly technical, such as stream pollution, calls for considerable skill. Obviously, any appeal to the layman through the written word must be couched in much more dramatic form and content than that found in a professional paper. Herein lies the danger that a "popular" presentation, designed to arouse an emotional response, may not fit the standards of precision by which the professional worker abides. Quite naturally, therefore, waterworks men have registered strong protests to an article in the current issue of the *Woman's Home Companion* titled "Foul—but you drink it!", as reported in our news pages last week (see Sept. 11, vol. p. 361). The title, the illustrative material and some of the statements take liberties with the precise facts of the case. But we question the possibility that this will destroy public confidence in the water supply profession and the works under its jurisdiction. On the contrary, we can now expect the lay public to be a lot more interested in water supply, and in a receptive mood to push the very reforms that the professional groups are working so hard to achieve. In fact, here is a rich opportunity for the American Water Works Association to tie in and emphasize its public-relations program by capitalizing on the wave of interest in water purity. There is a big story to tell, and what is more, a big audience has been made ready to hear it.

Better Pay for Highway Engineers

HIGHWAY BUILDING has been handicapped all season by a lack of engineers, due primarily to the fact that state highway departments with salary scales fixed by law have been unable to compete with private industry where compensation can be adjusted upward without long delays. The effect of this, coupled with the curtailment of new work due to greatly increased construction costs, is serious and calls for drastic action if highway building is to be kept from lagging farther and farther behind current needs. These needs, according to Charles M. Upham, director of the American Road Builders Association, call for $2 billion in road construction in 1948 and 1949. If engineers are to be obtained for such a program, the pay rates in state highway departments must be stepped up considerably. To do this calls for an active campaign on the part of state and local engineering organizations. Unless the heads of state highway departments are strongly supported in their requests for higher pay for their men, little will be accomplished. It takes numbers to impress legislators.

Boom in Research

A HIGHLY SIGNIFICANT characteristic of the times is the unparalleled popularity of research. Industry builds palaces to house it. An economy-minded Congress feels its heart softening and its purse strings loosening whenever the word is mentioned. Colleges and universities find state legislatures and private philanthropists swayed more easily by appeals for research than for any other activity. The result is a boom in research, such as the world has never seen.

To those who have long understood the fundamental importance of research and worked for its recognition, this development is highly gratifying. Yet it presents a number of sobering problems. For example, booms are historically associated with busts. There might be a reaction from the present popularity of research if war fears should dissolve, if tax laws should be changed to make research investments more painful, if government and business set too high a store in miracles that happen too slowly or not at all. There is a little too much exuberant lip service and ballyhoo connected with the current support for research for comfort.

Another problem posed by the great expansion in research relates to personnel. Research is a highly individualistic job, no matter how many of the trappings of big business it may don. Not only are men with specialist knowledge and skills required, but they must possess personal honesty, integrity and moral courage in high degree. Merely putting in time tinkering with test tubes and the other paraphernalia of the laboratory is not enough. There must be a driving force of idealism and service to mankind in the makeup of every research worker. To find enough workers of this kind to man large research organizations is not easy. Research on the scale that its present

popularity implies could fail because of a manpower shortage.

A third problem is that of direction or administration. Here again it is a matter not only of knowledge, but of integrity and vision, and above all of leadership compounded of enthusiasm and discipline. Not only must the director of research have the vision to select those lines of investigation that offer the most promise and the greatest return, he must be able to impart enthusiasm to the workers and keep them on the main line of study without encroaching too much on their necessary freedom of action. To secure such administrators in sufficient numbers for the greatly expanded research programs now envisioned is not the least of the problems that are faced.

Finally, research, which, originally was conceived principally with making new discoveries and fitting them to practical purposes has been broadened to include the accelerating of experience so that we may know in a matter of a few years, instead of decades or generations, what may be expected of a new structure or a product. This new function places on the research worker an obligation to have practical knowledge of the world about him as well as expertness in the physical sciences.

Perhaps our greatest assurance that research will discharge the new obligations it has assumed and had thrust upon it rests with the record made by long established research organizations, which have grown in stature and efficiency as the demands on them have multiplied. One of these is that of the Bureau of Reclamation in Denver. Born of the need of solving special problems incident to the design of Hoover Dam seventeen years ago, it has developed in skill and scope with each new task that expanding construction programs have imposed. Largely concerned with applied research, it has not avoided basic research when the possibilities for significant results have beckoned.

Coordinating learning and endeavor in physics, chemistry, geology, microscopy, petrography, fluid and solid mechanics and several other sciences, the Bureau of Reclamation has developed a staff that confidently expects to cope successfully with the larger and more numerous problems that are promised in the future. The record upon which this confidence is based will be presented in a series of articles in this journal starting in this issue. The articles will hardly furnish incontrovertible evidence that the problems created by the boom in research are not serious and difficult, but they will reveal how one organization has been meeting their challenge successfully as they have grown to their present magnitude.

If the boom does not bust, if this laboratory and others in and out of government continue to develop wise direction, knowledgeable and idealistic workers and a keen sense of economy and efficiency, research will attain that high pedestal upon which present popular enthusiasm assumes it already rests secure.

An Easy Way Out

LABOR LEADERS of the AFL are voicing their determination to resist by court action any attempt of employers to seek aid in new National Labor Relations Board machinery set up under the Taft-Hartley Act. They could relieve their blood pressure and serve their members better if they would accept the objectives of the act in the spirit in which they were formulated.

Nothing in the act violates or threatens the rights or prerogatives of labor. It seeks to stop jurisdictional strikes and secondary boycotts, which responsible labor leaders themselves frequently inveigh against. It gives employers the same rights as labor, but takes away none of labor's rights, either to strike or to bargain collectively, which only the unprincipled could object to. It requires union responsibility in handling and reporting funds and in honoring contracts, which the best of labor leadership has always endorsed. Only in the matter of the ban on the closed shop is there room for disagreement, and the abuses of this practice have been so great that the rank and file, if not the leaders, are glad to see it challenged.

Instead of worrying about whether construction is inter-state business, and thus subject to federal control, or intra-state, and therefore free of it, labor leaders could save their unions trouble and expense by merely mending practices that they know to be wrong and unfair. The easy way to avoid becoming embroiled in NLRB machinery is to give that agency no cause for setting it in motion.

ENGINEERING NEWS-RECORD
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Strain gages buried in the concrete forming Shasta Dam will provide new information for better design and construction of similar structures. Activities of this kind are under the surveillance of the Bureau of Reclamation's engineering laboratories.

RESEARCH LABORATORIES OF THE RECLAMATION BUREAU—PART I

Tools for Better Engineering

Robert F. Blanks
Chief, Engineering Laboratories
Bureau of Reclamation, Denver, Colo.

From the simple premise that no structure can be any better than the materials that go into it, there has developed what is probably the world's greatest research organization in the field of civil engineering and construction. In existence only seventeen years, the engineering laboratories of the Bureau of Reclamation have a record of rich accomplishment. From these laboratories have come findings that have a profound influence on the improvement of engineering practice and the advancement of technical knowledge.

Today, with its establishment in new quarters, the reclamation laboratories' staff looks forward to an intensified program of research and service. It is opportune, therefore, to examine the organization and its objectives. With this in mind a series of articles will be presented describing how the skills of the engineer, technician and scientist in various fields of endeavor are correlated in the solution of design and construction problems.

Prepared by members of the laboratories' staff, in collaboration with Stephen H. Poe, engineering information officer of the USBR, and the editors of Engineering News-Record, this group of six articles provides a singular opportunity for the civil engineer to understand how his activities are influenced and may be improved with the aid of the physicist, geologist, petrographer and the chemist.—*The Editors*

WHY does the Bureau of Reclamation need laboratories? The bureau is not a research organization but primarily is engaged in planning, designing, building and operating large water-control, irrigation and power projects.

To answer the opening question, one must look backward a bit. There was a time when reclamation engineers depended solely on their experience and judgment and on the old established tools and devices of engineering—the transit and level; the slide rule and handbook; the ball of earth rolled in the hand, how far a man in rubber boots would sink in the fresh concrete, or how the hammer rebounded when struck against hardened concrete.

Today it would be foolhardy to embark on a major engineering project without taking advantage of the many scientific aids that are available for developing and testing new materials and methods as well as improving past practices. This is the reason why the reclamation engineers find it necessary to maintain laboratories.

In these laboratories, which form an integral part of the engineering organization of the Bureau of Reclamation, are to be found experts in many fields of technical science. It is their job to apply and co-ordinate knowledge in physics, chemistry, geology, fluid and solid mechanics, petrography and microscopy to the solution of engineering and construction problems.

How the work got started

The reclamation laboratories were born of necessity seventeen years ago. At that time the answers to the many unusual problems imposed by the design and construction of Hoover Dam could not be found in textbooks or in the notebooks of experience. The occurrence of special problems did not end with Hoover Dam; there followed even more unusual ones at the Grand Coulee, Shasta, Friant and Anderson Ranch dams, the All-American Canal and other projects. From this back-ground it was learned that the new-found tools of science proved equally beneficial when applied to the everyday problems that arose not only in the design and construction of engineering works, but also in the planning, operation and maintenance stages.

Application of the technical sciences to reclamation problems by means of laboratory facilities has saved many times their cost measured in direct monetary value; in addition, it has resulted in better, longer lasting works and contributions to engineering knowledge that have attracted international attention.

Furthermore, a concerted effort is made at all times to keep in touch with and utilize the research work of all other agencies in order to avoid duplication of endeavor. Without the research findings of other organizations the reclamation laboratories could not function effectively; and without the reclamation laboratories,

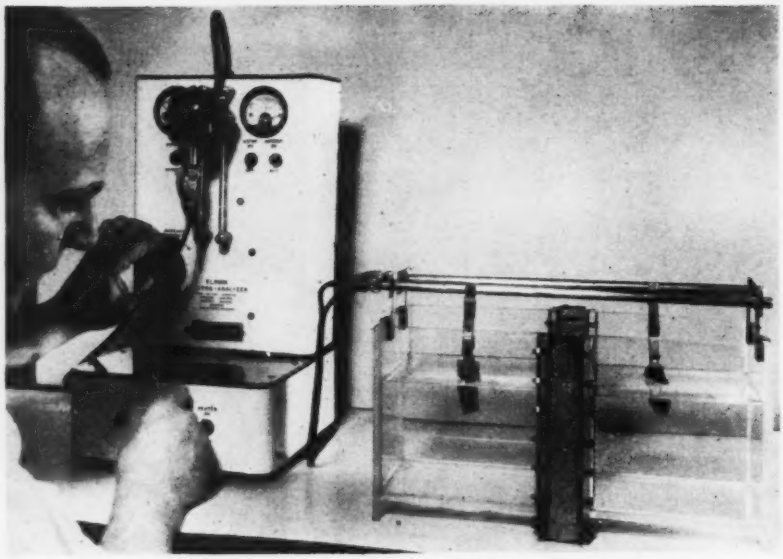


Fig. 2. One of the "tools for better engineering" is an electro-analyzer that finds application for testing the permeability of concrete. The sample under test is shown as the partition piece between the containers of electrolyte.

most of the technical knowledge developed by others would be lost to the bureau's engineering endeavors.

Officially known as the Engineering and Geological Control and Research Division, the bureau's laboratories are staffed with engineers, geologists and scientists of highest professional standing in their several fields.

A prominent engineer once compared the reclamation laboratories with a large medical clinic because they are functionally organized and equipped to attack engineering problems at many angles of approach and with the instruments and techniques most effectively combining the various sciences. To illustrate: the problem of determining why and how concrete disintegrates under service conditions is currently being investigated by physical, chemical and microscopic methods, by organizational groups specializing in physical testing, chemistry, geology, petrography and field research.

The advantages of this procedure are obvious: it permits thorough analysis (diagnosis), complete solution (treatment), and ultimate elimination of the trouble (cure).

Objectives of reclamation research can be classified into six groups:

1. Selection, utilization and control of construction materials. Example: Can a nearby source of reactive aggregate, which can be processed for use in concrete and transported to the structure site very economically, be used safely in combination with the cements and other materials available in the region, or must aggregate materials be transported from a considerable distance at greatly increased cost to the finished project?

2. Investigation of site, foundation, materials and all conditions of nature having a bearing on the engineering feasibility and treatment of proposed projects. Example: Is the severely sheared bedrock at the site of a proposed spillway structure competent to sustain the specific stresses which that structure will impose or, if not, would the expense of foundation treatment be so great as to require a modification of design?

3. Solution of current engineering problems arising in the designing office and in the construction field. Example: What is the best way to weld or braze metal water stops; and what is the most effective way of spacing concrete reinforcing bars?

4. Investigations leading to improved and more economical operation of completed works. Example: Studies to determine practical and reasonably inexpensive methods of eliminating troublesome aquatic weeds in canal systems.

5. Development of specifications, manuals and instructions covering the selection, utilization and control of engineering materials. Example: Specifications for sealing compounds for curing concrete; manual for materials exploration.

6. Investigation of a development nature leading to improved and more economical engineering practices. Example: Hydraulic model tests to determine a design for a needle valve that would minimize maintenance.

Future objectives

From the preceding outline of objectives, it becomes apparent that reclamation research primarily is verification-testing and applied research because it is directed toward finding practical solutions and answers for day to day problems.

There has been a growing requirement, however, for extending these research activities somewhat beyond this range, on the one hand to specific problems of the immediate future, and on the other hand to fundamental questions of the nature of certain actions involved in the study of specific problems. For convenience, the latter class of investigation is called basic research. It is necessary because available fundamental information does not meet all requirements; in other words, we have progressed beyond the development of pure research.

Future progress will be aided by the establishment of the laboratories in larger quarters, a move that has now been virtually completed. Taking advantage of the availability of several permanent buildings at the former Denver Ordnance Plant, some nine miles from the center of Denver, the decision was made last year to convert one of these to laboratory use.

A major advantage of the new location is the fact that ample outdoor space is conveniently available. The area assigned for such use is already provided with sufficient water, steam, power, light and other utilities. Embracing some 200 acres, this outdoor space will, for the first time, make it possible for the bureau's laboratories to construct models of river systems in connection with silt control studies, to make scale model canals and structures where performance of engineering materials can be observed in actual service under laboratory precision, to store various types of test speciments under outdoor ex-

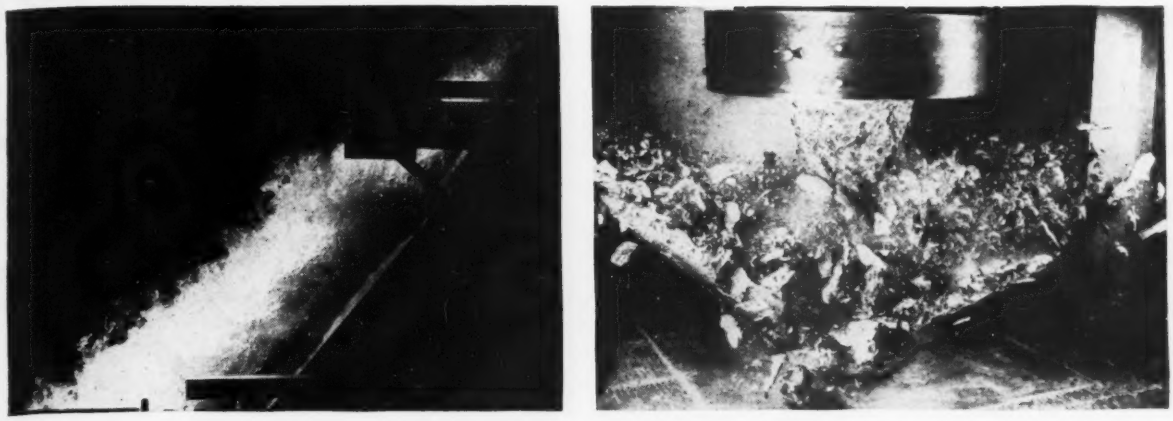


Fig 3. High-speed photography provides the means (left) for "stopping" the movement of swiftly flowing stream and thus expose extreme turbulence of a jet of water, and (right) for showing disintegration of a concrete core at the instant of failure under a load of 5,240 psi.

posure conditions, and, in short, to conduct a wider scope of investigation.

A measure of progress

At this point, one might ask: "What have these facilities contributed to the reclamation program?"

On a dollars-and-cents basis, the enumeration of typical accomplishments shows a direct monetary saving of $20,000,000 during the seventeen years of the laboratories' operation.

Some of these savings have come in large chunks. It is a conservative statement, for example, that in connection with the selection, utilization and control of concrete materials alone, the Bureau of Reclamation has obtained concrete of the required quality with at least one-tenth of a barrel less cement per cubic yard. During the laboratories' period of existence, this represents a saving, on 30,000,000 cu.yd. of concrete placed during that period, of $6,750,000.

Again, a less conservative design of the Grand Coulee spillway made possible by laboratory studies saved $5,000,000. And the decision to leave a portion of the Friant-Kern canal unlined, made possible by geological studies, saved $2,000,000. However, the largest aggregate economies accrue from the smaller savings accomplished on each of the hundreds of projects operated by the bureau.

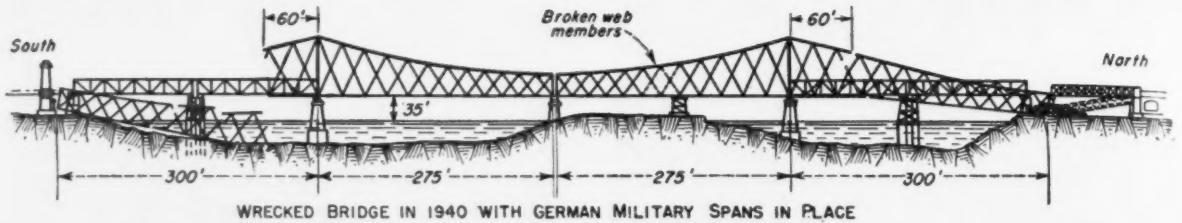
In addition to these dollars-and-cents accomplishments, there are those involving improved methods and techniques from which the bureau will collect a profit from every project it constructs in the future. As a result of research by the Chemistry Laboratory, a saving of $33,000 will result annually from better specifications and utilization of paint materials. Through the efforts of the same laboratory, the use of a sulfate-resisting cement will accomplish a $22,000,000 saving in the next twenty years through the avoidance of costly replacements and repair of concrete deteriorated through chemical attack by the alkaline soils so prevalent in the West.

Structural tests of a new type of pier for small bridges indicate the saving of perhaps $90,000 on 180 such bridges whose construction is now anticipated. Other tests by the structural research group are leading to a new concept of "ice thrust" against structures located in cold climates and a saving of $100,000 is anticipated on structures (exclusive of dams) now contemplated.

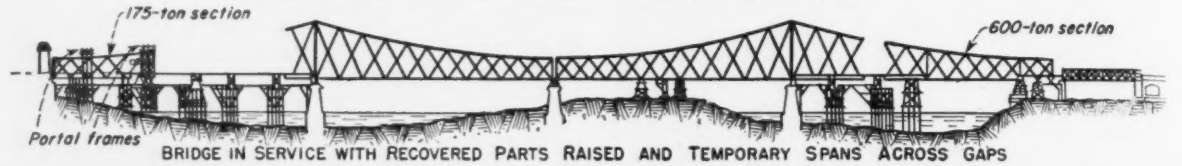
Hydraulic laboratory studies on the spillway of Davis Dam resulted in a direct saving of $190,000, but the application of the information thus obtained to other similar structures may be expected to save millions of dollars during the next few years. Hydraulic research in gates and valves, similarly, might be adduced to show large immediate savings but the ultimate saving will be even greater, aggregating millions of dollars.

But these appraisals, large as they are, ignore the major accomplishments. And these are: (1) the achievement of more efficient, more durable and safer structures; and (2) contributions to engineering and scientific knowledge for the benefit of all builders of engineering works.

Fig. 4. Relief maps are an important aid in making major decisions. This is a portion of the area in which the Colorado-Big Thompson project is located. Built on a 1:12,000 undistorted scale, this map gave graphic demonstration to the advantages and disadvantages of the various routes for proposed tunnels from the Continental Divide to the eastern foothills area.

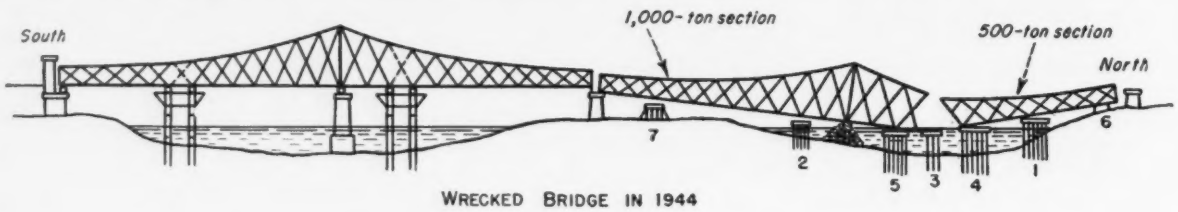


WRECKED BRIDGE IN 1940 WITH GERMAN MILITARY SPANS IN PLACE

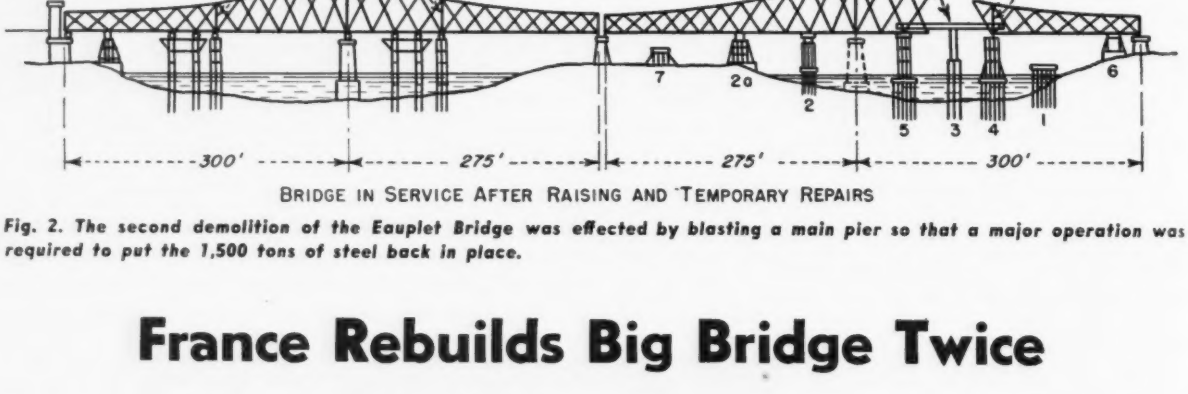


BRIDGE IN SERVICE WITH RECOVERED PARTS RAISED AND TEMPORARY SPANS ACROSS GAPS

Fig. 1. After its first demolition by the French Army in 1940, the Eauplet was put back in temporary service by the Germans and then rebuilt by engineers of the French National Railways.



WRECKED BRIDGE IN 1944



BRIDGE IN SERVICE AFTER RAISING AND TEMPORARY REPAIRS

Fig. 2. The second demolition of the Eauplet Bridge was effected by blasting a main pier so that a major operation was required to put the 1,500 tons of steel back in place.

France Rebuilds Big Bridge Twice

NO TYPE OF WAR reconstruction in France has progressed as far or as successfully as the restoration of railways, and specifically the rebuilding of bridges. Engineers of the S.N.C.F. (The French National Railways), time and again have demonstrated unusual skill, initiative and intelligence in transforming wreckage back into bridges. Moreover, in a discouraging number of cases they have rebuilt the same bridge twice—after the 1940 German invasion and again following the German retreat in 1944 and 1945.

One of the most notable of these twice-rebuilt structures is the 1,150-ft. double-track Eauplet Bridge across the Seine a few miles upstream from Rouen. Containing four spans (300-275-275-300 ft.) it is arranged in the form of two separate continuous lattice truss bridges of two spans each. At the north end there is also a 90 ft. deck approach span connecting with a short masonry viaduct that leads directly into a tunnel. Supported on masonry piers about 35 ft. above the water surface, the steelwork of the main bridge weighs 3,500 tons.

The first destruction of the Eauplet Bridge occurred in June, 1940 when demolition charges set by French army engineers severed the two end spans about 240 ft. out from each bank. On the south side the charge was placed on the span itself with the result that the broken end of the steelwork came to rest in the water while the other end slipped off the abutment onto the bank. At the north side the explosion charge was detonated in the abutment dropping the land end. This broke the chords 240 ft. out, but not the web members, which kept the damaged portion from complete collapse. At the same time, however, the bearings on the river pier were moved laterally 6 in., and damage was done the adjacent 275 ft. span in the form of a bent top chord

and of several broken web members near the center of the span. The destruction of the abutment also dropped the end of the deck approach span that rested on it.

Because a crossing of the Seine at this point was unusually important the German military engineers immediately undertook to repair the damage. But lacking time and materials they sought to put only one track back in service, and this by the most expeditious means, which was to place prefabricated military trusses across the gaps. In carrying out this work they increased the damage to the bridge by cutting out all members that interfered with their pile driving and steel erection. The result was that when the engineers of the French Railways were allowed to undertake permanent repairs soon thereafter, the task was greatly increased as well as being complicated by the necessity for maintaining train traffic.

How the French repairs were carried out is indicated in Fig. 1. Broadly it consisted in (1) driving piling falsework to carry a temporary welded box girder deck of short spans, which could be substituted for the German trusses; (2) raising this temporary deck as much as possible (considering the limitation imposed by the presence of the tunnel on the north approach) and constructing the new permanent deck beneath; and (3) raising and repairing the fallen truss sections at either end.

On the south side only a 175-ton truss section could be recovered intact. This was raised with a combination of eight 25-ton screw jacks on falsework and a block-and-tackle system hung from two portal frames that straddled the work. The lift was about 30 ft. The remainder of the truss was recovered piecemeal, although many of the members were so badly damaged that new steel had to be substituted. Erection of these members was accomplished with the aid of a portal gantry crane riding on rails on falsework along the sides of the bridge.

The north span presented a bigger lifting problem since a 600-ton section of the 300-ft. span could be recovered in one piece. Here, 200-ton capacity hydraulic jacks were used, concentrated at the abutment end and shimmed on a steel girder grillage. The same jacks were used to remove the lateral displacement of 6 in. and a vertical deflection of 10 in. from the adjacent 275 ft. span.

Fig. 3. Back in service after being wrecked and rebuilt twice, the Eauplet Bridge at Rouen again carries all main line trains between Paris and Le Havre.

Such brief description hardly does justice to the difficulties that were met and surmounted, but by the end of 1942, the Eauplet Bridge was completely restored. Less than two years later, in June 1944, Allied bombing and German demolition had again damaged the south half of the bridge and dropped the entire north half into the Seine. A second reconstruction had to be undertaken, and it has only recently been entirely completed.

The greatest damage of this second demolition effort resulted from destruction of the center pier supporting the two continuous spans of the north half of the bridge. In falling, the shore span broke in two, the abutment end was displaced 8 ft. laterally, and numerous members were bent near the abutment end. In the north half of the bridge both spans suffered severed bottom chords, and several bent web members.

The falsework bents required in making the repairs are indicated in Fig. 2. In the north half, the landward section, weighing 500 tons, was first raised out of the water and moved back to its longitudinal axis with 200-ton hydraulic jacks resting on bent 1. The jacks were then placed on bents 4 and 6, and the section lifted to the horizontal and moved lengthwise onto the abutment.

The large section of this part of the bridge weighed 1,000 tons. The first lifts were taken over bents 2 and 7, at the same time the steelwork was moved sideways to its normal longitudinal position. Final lifting was aided by jacks on bent 5.

A temporary beam deck was placed between the two raised sections to permit train movements while the missing truss members were being fabricated. During this time also, since continuity of the truss was not reestablished and the center pier not yet rebuilt, bent 2a was installed in the center of the 275-ft. span to enable it to carry double-track train loads.

The south half of the bridge, requiring no raising but only repair and replacement of damaged members, was merely supported by falsework bents as shown. At the present time, as indicated in Fig. 3, all falsework has been removed from the river, so that as before the war, all main line trains between Paris and Le Havre cross the Seine at Rouen on the Eauplet Bridge.

Full-Size Timber Trusses Tested Under Long-Time Loads

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***Contents in Brief**—Full-scale tests on two types of timber trusses demonstrate the conservatism of the recommendation for 15 percent increase in connector values for loads of three months or less duration and for 20 percent reduction where material is fabricated unseasoned but is seasoned when used. Both trusses carried the same proportion of overload, but the Lank-Teco truss had half the deflection shown by the flat-Pratt and used half the material.*

ANALYSIS of data obtained from tests on 48-ft. flat-Pratt and Lank-Teco timber trusses reveals valuable information on connector strengths and on the relative performances and efficiency of the two designs. Both trusses performed satisfactory despite differences in composition, seasoning and exposure.

The design of the Pratt truss (Figs. 2 and 3) assumed a load of 40 psf. on trusses spaced at 16 ft., dry material in fabrication, truss dry in service and three months maximum duration of design load. Actual conditions were green material at fabrication, exposure to the weather during test and full design load for nine months. Thus, the truss was subjected to the worst type of conditions, as was the case with many trusses during the war period. Also, old-type single-bevel rings were used.

The corrected design load for this truss for the conditions of the test is 29.7 psf. This is based on standard design recommendations for permanent loading (load exceeding three months); material seasoned after fabrication (the truss was fabricated green and exposed to the weather, but it is assumed that it partly seasoned in places and the computations were made as though it were completely seasoned); non-dense Douglas fir (1,450*f*); group B split-ring connector loads; and the most critical joint being stressed to 100 percent of the allowable working load.

On the other hand, the Lank-Teco truss (Fig. 1 and 3) was fabricated of dry material, remaining dry in service, and the only adjustments necessary in design load were for duration of load and 100 percent stress in the critical joint. The corrected design load is 38.5psf. A comparison of the various data is given in the accompanying table.

The table indicates that the Lank-Teco truss is only one-half as expensive as the flat-Pratt since it requires one-half the material and labor. Considerable material is saved through the elimination of many web members and splice plates and through the use of a 3-member spaced column. Since both trusses carried the same proportion of overload, it can be concluded that the Lank-Teco is a better balanced design for a 48-ft. span.

The Lank-Teco truss deflected half as much as the Pratt. This performance can be attributed to a reduction in the total number of joints (fewer members), the use of lapped-chord splices instead of butt, and the substitution of double-bevel split rings in grooves conforming to the ring cross-section for single-bevel split rings in rectangular cross-section grooves.

Fig. 1. Lank-Teco truss, under test on a 48-ft. span, was loaded with sand and protected from the weather by a tarpaulin.

Method of testing

In the tests, the trusses were supported on a concrete pedestal at one end and on a wood column on a

concrete foundation at the other end (Fig. 3 bottom). Cresoted wood poles set in concrete foundations were spaced along the span to provide lateral support by means of wooden struts at various points along the top chord. These struts were hinged so that no vertical restraint was imparted to the truss, and the deflection of the trusses was so small that no significant side movement of the top chord resulted from having the struts of fixed length.

Load was applied at the five interior panel points through a hardwood block attached to the lateral struts and bearing on the top chord of the truss. In cases where the top chord was not horizontal, triangular wedge-shaped blocks were glued to the top chord under the hardwood blocks.

Test loads consisted of a sand box suspended from steel stirrup rods over the bearing blocks (Figs. 1 and 2). The sand box was not continuous over adjacent panel points, and thus, different deflections of adjacent panels could not change the load distribution. Total capacity of the sand box plus dead weight of the rig and truss permitted loading to about four times the average design load for a 48-ft. truss.

Fig. 2. The flat-Pratt truss was fabricated green and exposed to the weather during testing.

Fastened at the concrete pedestal and extending under the truss to the column end, a fine piano wire facilitated deflection readings at any point along the bottom chord. This wire was maintained at constant tension by means of a pulley and a suspended weight at the column support.

After the truss was in position with the lateral strut bracing attached, the empty sand box, previously leveled, was raised from block supports and its weight suspended from the truss by means of the turnbuckles on the rods. General procedure in these two tests was to add no additional sand load until the truss had adjusted to the dead load of the rig. Thus, for two weeks or longer, the truss carried only its own weight plus the weight of the sand box. Frequent deflection readings were taken to assure that the truss had become stable, or reached a constant deflection, before additional sand load was applied.

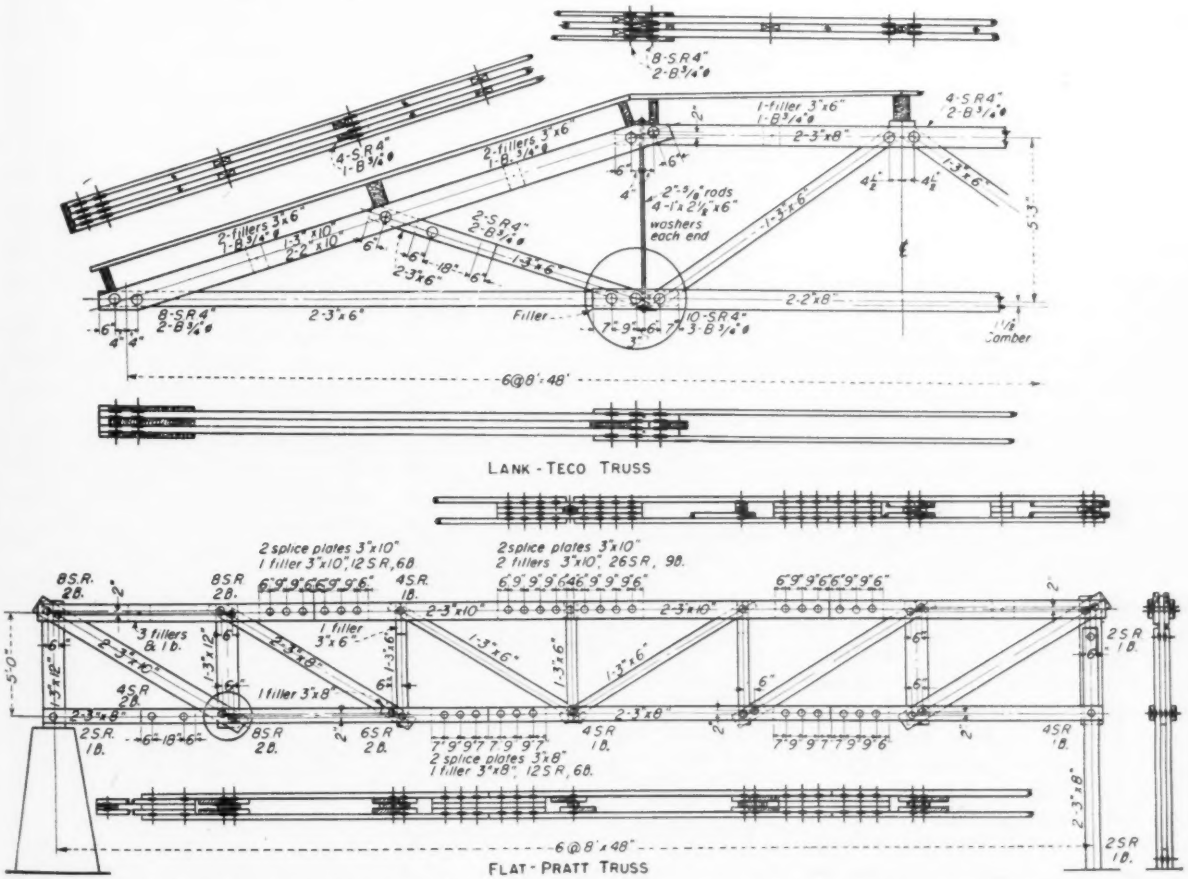

Fig. 3. The Lank-Teco truss, requiring about half as much material as the Pratt, utilizes lapped-chord splices, steel tension rods, three-member spaced columns using two thicknesses of material and double-bevel split rings.

Generally, one-half to three-quarters of the deflection would occur within 24 hr., with maximum dead-load deflection being reached within one week.

After the initial period, sand was added uniformly until the desired total load was reached. This load then remained on the truss for a long time. Deflection readings were taken during operations and daily thereafter.

The final stage of the test was the application of additional load until failure occurred, accomplished by increasing the load in small equal increments, with deflection readings being taken before and after each increment was applied. In this way, it was usually possible to observe the joints and members and to determine, prior to failure, the joint or member that would be critical. With small increments of load, it was possible to determine within reasonable limits the load of the truss at failure. The deflection readings gave a load-deflection curve from which the proportional limit of the truss as a unit could be determined.

Tests results

A load-time-deflection graph and deflections during final loading for the Pratt truss are shown in Fig. 4, and for the Lank-Teco in Fig. 5. The joints that caused ultimate failure of the trusses are circled in Fig. 3.

In the Pratt truss, failure occurred in the double 3 x 10-in. diagonal members, which were loaded at an angle of 32 deg. to the grain. Through seasoning checks or splits were present in the ends of most of the web members during the last three or four months of the test. The split in the diagonal member that failed first was open $\frac{1}{8}$ to $\frac{3}{16}$ in. and extended along the grain from the end of the piece up, under and on above the chord member, intersecting the bolt hole nearest the center of the span. As final overload was applied, this split closed up and another split opened, which extended parallel to the initial split, from the end up through the other bolt hole. The two splits were about $1\frac{1}{2}$ to 2 in. apart. At failure, the two splits were joined by shearing out of the wood adjacent and between the connectors, and the center, wedge-shaped section of the diagonal (full thickness of diagonal) sheared out.

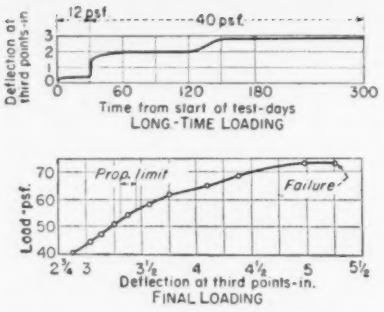

Fig. 4. Pratt-truss load-time deflection curve and deflections under final load.

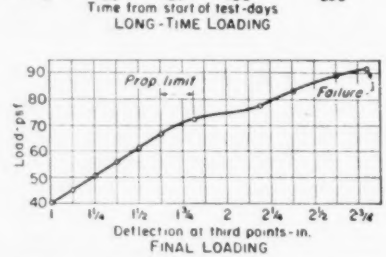

Fig. 5. Lank-Teco-truss load-time-deflection curve and deflections under final loading.

The other diagonal failed immediately and the end of the truss collapsed.

In the Lank-Teco truss, failure occurred in the outside 2 x 8-in. bottom-chord pieces, which were loaded parallel to the grain. Seasoning checks or splits were present in the ends of these chord pieces during the last few months of the test. The largest split, open about $\frac{1}{8}$ in., extended along the centerline grain of the member from the end of the piece through the three bolt holes in the splice. Final failure, occurring as a shearing out of the wood parallel to the grain in line with the split rings in the splice, was a typical tension-parallel-to-grain failure.

In view of the correspondingly good performance of the Lank-Teco truss, the unique features of design that contribute to its overall economy should be borne in mind for application to other trusses. The lapped-chord splice is adaptable to almost all designs. A steel tension rod is sometimes advisable where it is difficult to frame a wood member. The three-member spaced column using two thicknesses of material offers an opportunity for savings in material, but unfortunately no design recommendations for such a combination are available.

These design features, together with the use of the better fitting double-bevel split ring, contribute to the lesser deflection of the Lank-Teco truss. It is impossible to determine how much of the difference is due to improved design features and the better fitting connectors, inasmuch as a portion of the deflection of the Pratt resulted from the use of green material and subsequent extreme exposure conditions.

Truss performance measured

The last seven items in the test data table are measures of truss performance. The points of prime importance are items 9 and 10, giving ratios of test loads to the recommended design load. It is apparent that the flat-Pratt performed as well or better than the Lank-Teco in load-carrying capacity. This leads to the obvious conclusion that the design procedure for the unfavorable conditions of the Pratt test are at least as conservative as the design procedure for the favorable conditions of the other test. Thus, it is felt that recommendation of a 20 percent reduction in allowable connector-load value for

TEST DATA FOR TIMBER TRUSSES

	Flat Pratt	Lank-Teco
1. Span—ft	48	48
2. Spacing—ft	16	16
3. Feet—b. m.	1,036	561
4. Split rings	156	68
5. Bolts	58	28
6. Teste load—psf	40	40
7. Calculated allowable permanent load (as tested)—psf	29.7	38.5
8. Load at failure—psf	74	92
9. 8 ÷ 7	2.49	2.39
10. Proportional limit load ÷ 7	1.8—1.9	1.75—1.85
11. Deflection at 40 psf.—in.	$2\frac{7}{8}$	1
12. Deflection at failure—in.	$5\frac{1}{4}$	$2\frac{5}{8}$

material fabricated green but dry when used is conservative.

In view of the fact that the Pratt truss was not actually dry when used, but alternately wet and dry, it may be permissible to extend the 20 percent reduction to cover such a condition. Thus, it might apply to connectors used in material fabricated green and dry in use, or dry, occasionally wet but quickly dried, in use. In either of these two cases, allowance should be made, if necessary, in the design for possible favorable decay conditions in green or wet lumber.

Both test trusses carried total load for seven months or longer, with no increased deflection in the last four months and elastic performance to 1.75 or 1.85 times design load during final loading to failure. The Pratt truss actually carried a 35 percent overload for nine months and yet performed better in regard to proportional limit and ultimate load than the Lank-Teco, which was not overloaded. It is evident from the proportional-limit ratio that no apparent damage was done by this overload. Thus, the recommendation of a 15 percent increase in allowable connector-load value for loads of three months or less duration in combination with permanent load, if permanent load does not exceed 25 percent of the total load, is conservative.

This limitation on the ratio of dead load to total load of 25 percent might be improved. A better approach would be to allow no increase for the portion of stress resulting from permanent or dead load and to apply an increase to that portion of the stress resulting from the three-month load. If 15 percent is correct for a combination of permanent plus three-month load, then a factor to be applied only to the latter should be somewhat larger.

During the three months when total load is applied, no differentiation can be made between permanent and three-month load; both types of load have the same effect on the truss.

To investigate cycle loading, which is analogous to snow load, another test is under way.

Tests were conducted at the wood products development shop of the Timber Engineering Co. at Washington, D. C., under the supervision of E. S. Lank and the writer.

Chart for Pumice-Concrete Beams

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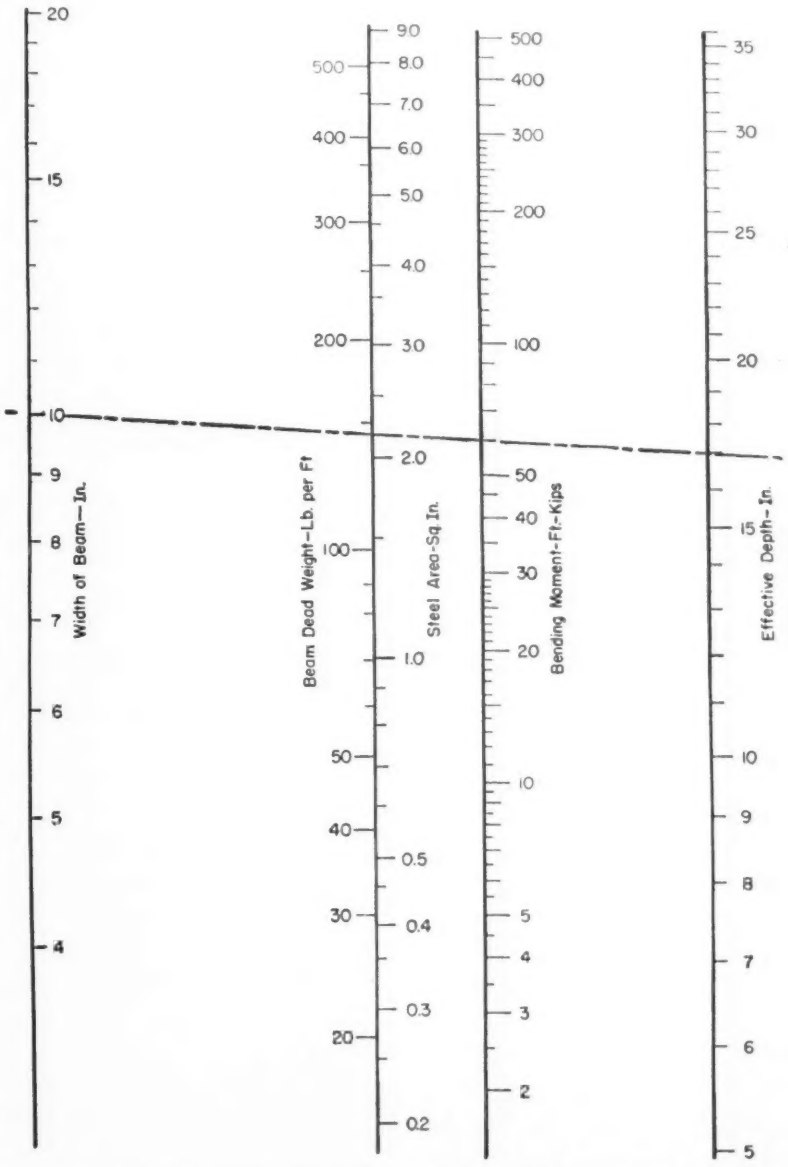
Design of reinforced-concrete buildings at the Naval Ordinance Test Station at Inyokern, Calif., where extensive use was made of lightweight concrete, was simplified by means of the accompanying nomograph. It differs from design charts for conventional concrete in that the ratio of modulus of elasticity of steel to that of concrete, n, is 40, instead of 10, 12 or 15, as commonly assumed.

The aggregate used is pumice because of the almost limitless supply located on the 1,025 square miles of Navy reservation. Transportation costs are absorbed by the vendor, Paul R. Splane, whose price of $3.50 per cu. yd. is for 1-in. pumice deliv-



Design chart for reinforced concrete with pumice aggregate, assuming modular ratio of 40 and allowable bending stresses of 1,000 psi. for concrete and 24,000 psi. for steel. Dashed line is used to solve illustrative problem.

ered into mixing hoppers at the station.

Structural concrete having a 28-day compressive strength of 2,800 psi. and weighing only 110 lb. per cu. ft. is produced by mixing 7 sacks of cement, 36 gal. of water, 9.04 cu. ft. of sand and 9.8 cu. ft. of 1-in. pumice per cu. yd. of concrete. It can be cut with a carpenter's saw, and nails can be driven into it.

Design stresses for this product are 1,000 psi. for concrete and 24,000 psi. for reinforcing steel. The modulus of elasticity is 750,000 psi, and therefore, $n = 40$.

Beam sizes obtained from chart

To facilitate design of beams, the nomograph shown on the preceding page was made. It gives the size of beam and the reinforcing steel required based upon these flexural stresses and $n = 40$.

As an example of the use of the chart, consider the design of a beam in which the maximum bending moment is 60 ft.-kips and in which the width is limited to 10 in. On the width scale, place a straight edge at 10 and align it to intersect the moment scale at 60. On the depth scale, read the intersection point of 17 in. for the effective depth of steel. About 2 in. of concrete cover over the steel is usually required by code, so that the beam dimensions would be 10 x 19 in.

Reinforcing steel required is given by the intersection of the straight edge with the steel-area scale. In this example, it appears that 2.2 sq. in. are required or five $\frac{3}{4}$-in. dia. bars. However, the beam width of 10 in. will not accommodate five bars placed in one layer, so that proper choice of steel would probably be three 1-in. dia. bars.

The steel area thus furnished would be in excess of that required, but bond and shear stresses still have to be investigated. Dead weight of the beam would be about 145 lb. per ft.

Stone and pumice concretes compared

A beam made of sand and gravel concrete, subject to the same stresses and the same conditions of design, except that $n = 12$, would be 10 x 24 in., with an effective depth to steel of 22 in. The steel area required is 1.55 sq. in., equivalent to five $\frac{5}{8}$-in. or three $\frac{7}{8}$-in. dia. bars. Thus, more concrete but less steel is needed. However, because of the depth of the beam in relation to its breadth, investigation would have to be made of diagonal tension stresses and of the need for stirrups. Dead weight of this member would be about 250 lb. per ft.

Pumice concrete advantageous

It is immediately apparent that the pumice-concrete beam can carry a greater live load than the sand-and-gravel concrete beam. If a saving in headroom is important, then the pumice-concrete member would prove desirable because it is 5 in. shallower. There is also a saving of 21 percent of volume of concrete at the expense of an increased amount of steel.

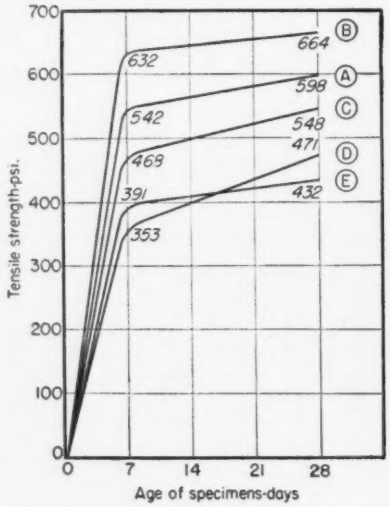
The nomograph can be used whenever any two of the four design factors are known. A straight line drawn between the two known points determines the other two unknown quantities.

Order of Mixing Affects Concrete Strength

Australian research engineers have been experimenting with different procedures in concrete mixing to determine whether the order in which water is added has any effect on the ultimate strength of concrete. For optimal results, they wondered, should water be added to a mixture of cement, sand and coarse aggregate, as in common practice; should cement and water be mixed first before aggregates are incorporated; or should some other order be used?

If two or more mixes are made using sand, cement, aggregate and water in identical proportions, the resulting concretes are not necessarily the same. The order of mixing has a not inconsiderable effect on the strength, according to tests performed in the laboratories of Rocla Limited, Melbourne, Australia.

These tests showed that 11 percent better tensile strength is obtained when fines and cement are mixed dry, water added, and then the coarse aggregate than when sand, cement and coarse aggregate are mixed first. The revolving drum-type mixer is not suited to the former order of mixing, because the fines tend to stick to the buckets of the drum and are difficult to wash out with the water when subsequently added, according to the research engineers. However, the revolving pan-type mixer produces a well-mixed concrete irrespective of the change in procedure.



Curves show the effect of various mixing procedures on tensile strength of concrete.

To explore further the effect of the mixing sequence, tests were carried out also with mixtures in which cement and water were mixed first and aggregate introduced later. The series covered the following sequences:

A. Sand and coarse aggregate mixed dry; cement added; water added.

B. Sand and cement mixed first; water added; coarse aggregate added.

C. Cement and water mixed; sand added; coarse aggregate added.

D. Cement and water mixed; coarse aggregate added; sand added.

E. Cement and water mixed; then coarse aggregate and sand mixed separately and added.

The tensile strength obtained for each sequence is indicated in the graph. Compression strength closely approximated these results.

Grit and Grease Chamber Reduces Sewer Cleaning and Pollution Problems

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Contents in Brief—*Sewage from Salem and Peabody, Mass., carries wastes from 54 leather-making industries that is high in grease and silt content, which forms encrustations in the outfall sewer. To maintain carrying capacity, cleaning operations must be carried on throughout the year. Furthermore, some wastes have been dumped directly into the North River creating a serious pollution problem. State legislation enacted in 1945 ordered construction of a grit and grease removal chamber to abate this nuisance. With completion of this project, the sewer maintenance problem will be minimized.*

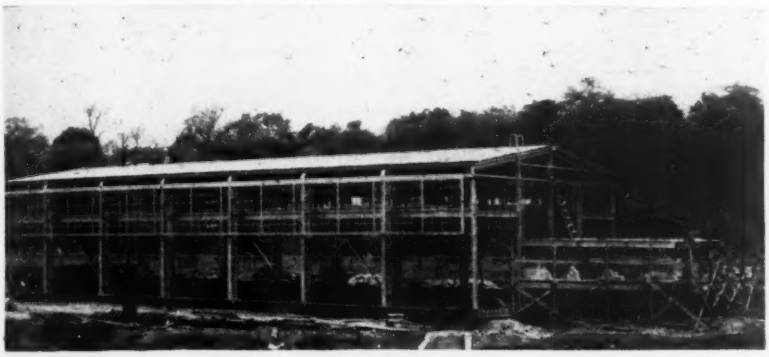


Fig. 1. Construction of the housing for the Salem-Peabody (Mass.) grit and grease chamber features a steel rigid frame and cinder block walls.

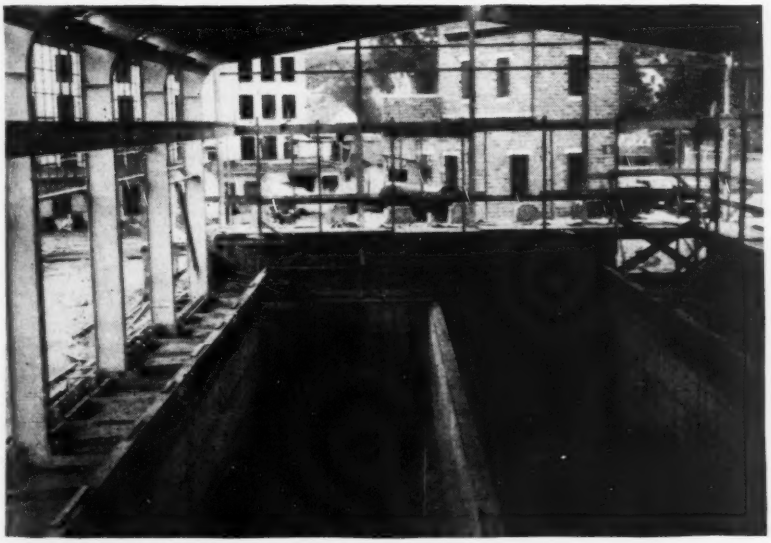


Fig. 2. Grit and grease removal tanks built of reinforced concrete contain hopper bottoms. Steel rigid frames support the roof and crane girders.

CLEANING of the outfall sewer that serves the cities of Peabody and Salem, Mass. has been a difficult and costly every-working-day-of-the-year problem. Although operations have been continuous and unremitting, it has not been possible to keep the sewer free of deposits, or of top and side encrustations. Consequently, carrying capacity of the sewer has been inadequate.

In the past large quantities of waste have been discharged directly into the North River either at industries or from relief gates in the trunk sewer. To relieve such contamination, the state legislature in 1945 passed an act that called for construction of a grit and grease chamber at or near the Salem-Peabody boundary. As a result of this mandate two improvements will accrue: sewer maintenance costs will be reduced and pollution will be decreased in the North River.

The city of Peabody is served by a system of separate sewers. The total area served is about 1,300 acres with a resident population of about 22,000. In 1943, according to the Massachusetts Department of Labor and Industries, there was a total of 94 industrial establishments in the city, of which 56 were engaged in the leather or leather-goods industries. In 1945 the total sewage flow, based on week-day industrial flows and on wet-weather groundwater allowances, was estimated as follows:

	Domestic sewage	Industrial wastes	Ground water	Total
Average mgd.	1.5	5.9	2.0	9.4
Maximum mgd.	3.0	13.0	2.0	18.0

Sewage and industrial wastes from Peabody discharge to a trunk sewer which also serves the city of Salem. This trunk sewer is 52 in. in dia. at the Salem-Peabody line and grad-

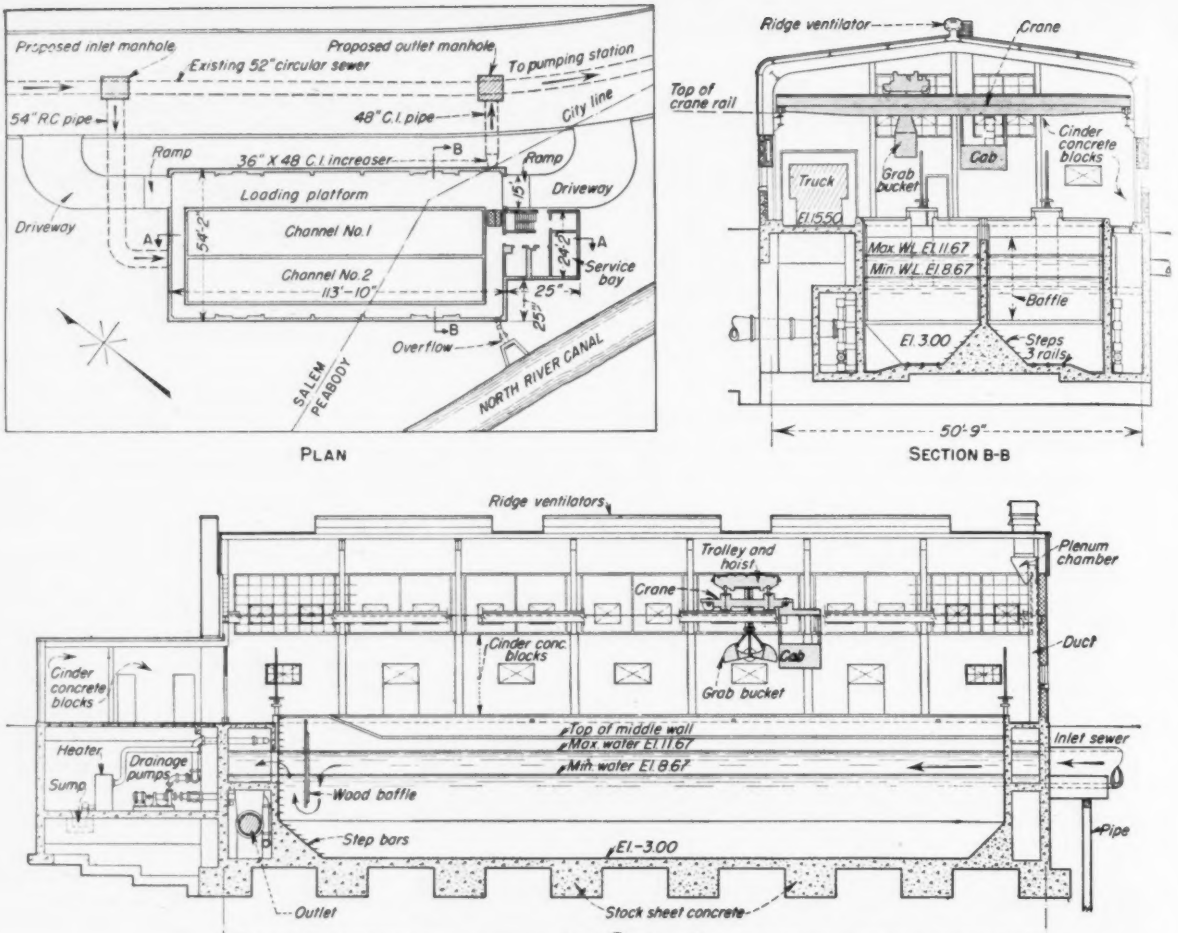


Fig. 3. Dual reinforced concrete grit and grease chambers are covered with a steel rigid-frame and cinder block building. A grab bucket suspended from a motor-operated overhead crane conveys sediment and scum from tanks to trucks operating along the loading platform. Prior to cleaning, one tank is dewatered by means of drainage pumps that force liquor to the inlet of the tank remaining in operation.

ually increases in size through Salem to 72 in. at the pumping station, a distance of 14,870 ft.

For many years large quantities of heavy solids and grease have been discharged to this sewer from the manufacturing plants in Peabody and Salem but in particular from Peabody. Despite the fact that sewer cleaning operations are carried out constantly, it has been found impossible to keep the sewer sufficiently free from deposits on the bottom and encrustations on the side and under the roof, to maintain adequate carrying capacity. Large quantities of wastes have been discharged to the North River either directly at the industries or through relief gates from the trunk sewer.

During 1945 the Massachusetts legislature passed an act providing for the construction of a grit and grease chamber at or near the Salem-Peabody line in order to abate or prevent the pollution of the North River. The work is under the jurisdiction of the South Essex Sewerage Board, which is responsible for the collection and disposal of sewage in Salem, Peabody, Beverly and Danvers.

Plans and specifications for the proposed grit and grease chamber were prepared during 1946. The chamber is designed for the collection and removal of materials from the sewage which would otherwise tend to settle in the trunk sewer or to become attached to it, thereby reducing its carrying capacity and introducing a serious maintenance problem.

Two channels are provided, affording a detention period of 22½ min. at the average design rate of flow of 11.5 mgd. plus storage capacity for about 250 cu. yd. of grit, sludge and scum. Each channel is about 99 ft.

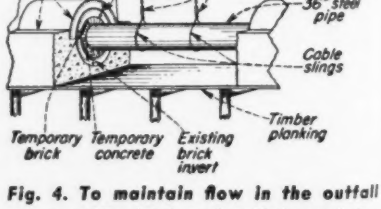


Fig. 4. To maintain flow in the outfall sewer while inlet and outlet manholes are built, a temporary 36-in steel pipe will carry the flow through the construction area. The annular space between the steel pipe and the walls of the sewer is packed with brick and concrete.

long, 16 ft. wide, and 14 ft. 8 in. deep. A truckway is provided along one side of the channels. The channels and loading platform are covered. A Venturi meter is provided for measurement of the flow. Typical sections of the channels are shown in Fig. 3.

Normally both channels will be in operation. Grease and other floating solids will be retained by a baffle near the outlet end of the channels. Settled solids will be collected in the bottom of the channels.

Consolidated grease and scum floating in the channels can be removed without taking the channel out of service and without first removing the liquid in the zone between the sludge and scum. However, for removal of grit and sludge it is proposed that one channel at a time be taken out of service. Liquid removed by drainage pumps will be discharged to the inlet end of the other channel remaining in service.

Four drainage connections will be provided for each channel near the outlet end. The lowest connection will be into a sump extending 1 ft. below the channel bottom, the other three will be directly above, spaced at 3-ft. centers. These multiple connections are provided to permit selective withdrawal of liquid above the sludge and below the scum. The lowest connection can be used for draining the channel.

Two drainage pumps will be provided, each of 400 gpm. capacity. The pumps may be operated together to give a total capacity of 750 gpm. One pump will remove liquid from one channel in about 1½ hr. and two pumps operating together will accomplish the same result in about 2½ hr. The pump will be suitable for handling sewage solids and will be equipped with self-priming devices. The pumps and piping will be provided with appropriate cleanouts and flushing connections.

Sludge removal by a grab bucket

Scum and sludge will be removed from the channels by means of a 1/2-cu. yd. clam-shell bucket operated from an overhead crane. The motor-operated crane will travel longitudinally along the channels, and across the channels and over the driveway. Watertight trucks similar to those now used will be driven into the building and the material removed by the bucket will be deposited in the trucks.

Each truck after filling will be washed down so as to be clean and unobjectionable to sight and smell as it leaves the grit chamber. Any spillage on the tops of walls, driveway and walks will be flushed back into the channels.

Material removed by the grab-bucket from grit chambers will be transported for disposal in dumps until such time as facilities become available for its incinerations.

The contractor's estimate shows this partial breakdown:

Excavation, sheeting and dewatering—7,000 cu. yd. at $8.00	$56,000
Concrete—1,690 cu. yd. at $30.00	50,700
Reinforcing steel—83 tons at $120.00	9,960
Structural steel—72 tons at $220.00	15,840
Brick masonry—108 M at $70.00	7,560
Cast iron pipe, valves and fittings	10,000
Sewage meter, recorder and liquid level gage	5,250
Traveling crane and clamshell bucket	12,700
Plumbing and heating	3,000
Electric	2,650
Wire fence	2,000
Drainage pumps	1,600

To take off and return sewage to the outfall, two intercepting manholes will be built while flow is maintained. This will be done by means of a 36-in. steel pipe located along the centerline of the 52-in. outfall as shown in Fig. 1. Temporary brick and concrete bulkheads—separated far enough to permit manhole construction—will be built to fill the annual space between the steel pipe and brick sewer. Cable slings with turnbuckles hung from a steel I-beam will support the pipe at third points.

A contract for the construction work was awarded on the basis of competitive bids to Munroe-Langstroth, Inc., North Attleboro, Mass. at a lump sum price of $209,163. Work was started on June 13, 1946. Completion was scheduled for February 17, 1947, but is being held up by delay in delivery of cast iron pipe.

The work is under the jurisdiction of the South Essex Sewerage Board, Joseph C. Tommassello, Chairman, Elihu A. Hershenson, Treasurer and Clerk, A. Preston Chase, Frank J. McCarthy, Frank P. Morse and Albert H. Richardson, with Chester L. Nyman, District Engineer. Metcalf & Eddy are engineers for the work with William W. Lundgren, resident engineer.

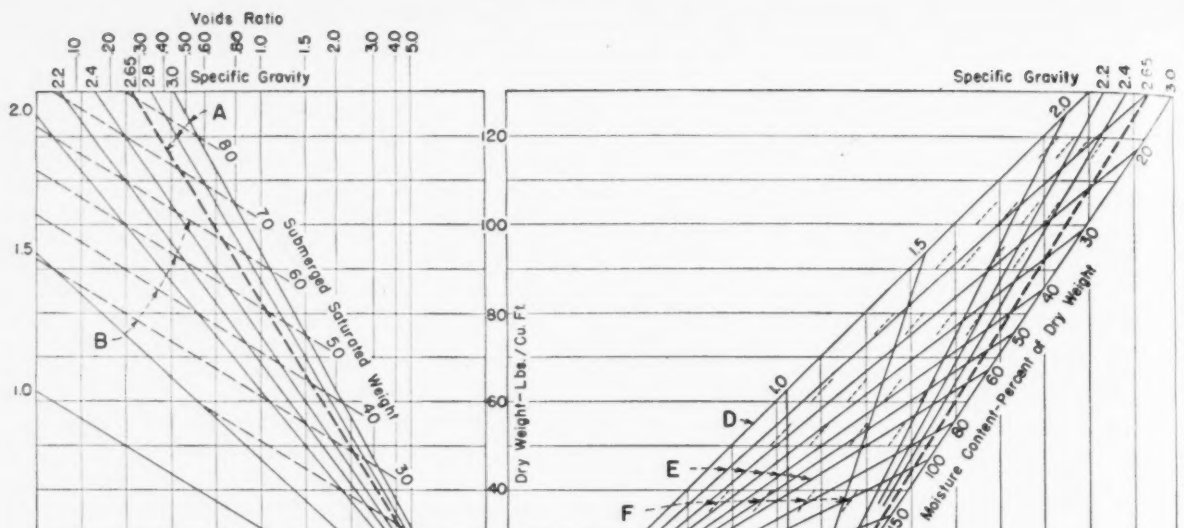
New Indicator Measures Stress Caused Dimensional Changes

Accurate measurement of minute, rapidly changing dimensions caused by stresses in structures of all kinds is possible by means of a new strain indicator developed at the David W. Taylor Model Basin of the U. S. Navy at Washington, D. C. Four models have been built and used. One was used in flight testing of aircraft and another to indicate strains in various parts of large engines.

By means of this strain indicator changes in length of a specimen as small as 8 millionths of an inch per inch can be recorded, even though the changes occur at a rate of 200 per second.

Use of the indicator with a "metalectric" gage consists of impressing variations in the flow of electric current through the gage, resulting from variations in resistance caused by dimensional changes, on an oscillating or "carrier current" similar to that used in radio. The circuit, includes resistors, amplifiers, detectors, and meters set up in such a way as to maintain electrical balance in the circuit except for fluctuations caused by the dimensional strains. By use of gages in pairs, spurious indications that might be caused by changes in temperature are eliminated.

A report, "A Carrier-Type Strain Indicator" (PB-57506; photostat, $3; microfilm, $1; 36 pages, including photographs, diagrams, and tables) has been published. Orders for it should be addressed to the Office of Technical Services, Department of Commerce, Washington, D. C., and should be accompanied by check or money order, payable to the Treasurer of the United States.



Variables in completely saturated or completely dry soil can be determined from the left-hand section of the chart while the right-hand side of the chart applies to partially saturated soil.

Chart Facilitates Determination Of Unit Weights of Soils

Eugene H. Harlow
Foundation Engineer with Frederic R. Harris, Consulting Engineer
New York City, N. Y.

***Contents in Brief**—Soil weights at various moisture contents can be quickly determined from a simply made chart. If any three of the seven major variables in soils are known, all of the other factors can be determined from the chart.*

IN PROBLEMS involving the unit weights of soils at various moisture contents, it is often convenient to be able to determine at a glance consistent values for a particular soil of known specific gravity. The accompanying chart is useful for this purpose. Its application may be of value in a wide variety of problems, including soil studies and design work of all kinds.

The left-hand portion of the chart applies to completely saturated or completely dry soils. Along any of the lines for specific gravity A, radiating from the lower right-hand corner, dry weight in pounds per cubic foot (designated pcf. in this article) may be read as an ordinate and porosity (or voids ratio) as an abscissa. At any particular point on one of these lines, corresponding to a particular value of dry weight and porosity, the submerged saturated weight may be read or interpolated between the parallel lines, B, slanted upward from right to left. The saturated weight in air is equal to this submerged saturated weight plus the unit weight of water (62.4 pcf.)

The right-hand portion of the chart applies to partially saturated soils. Weight in air is plotted as abscissa and dry weight as ordinate. A series of "limiting lines," C, for the various values of specific gravity, radiate upward from the base with a center at a point corresponding to weight in air = 62.4 pcf. These lines represent the variation of saturated weight in air for values of dry weight, at different specific gravities. Each line intersects a common diagonal line, D, sloping upward from the origin, corresponding to dry weight on either scale. Points representing any degree of saturation for a given soil lie within the area bounded by this common line, the appropriate specific gravity line and the base. Superimposed on this triangle, a series of lines, E, radi-

ating from the origin, serve as a grid on which moisture content in percent of dry weight may be read or interpolated. A secondary series of lines, F, radiating downward from the apex, may be used to read percent saturation (shown in the chart as dashed lines for a soil with specific gravity = 2.65).

Many interesting relationships are self-evident from this chart. It will be observed that if *any* three of the seven major variables are known, all other relations may be read from the chart. Moisture vs. density relations for typical soils, when plotted on the right-hand portion of the chart, reveal striking similarity in shape, characterized by sharp peaks occurring at 75-90 percent saturation, even for clay soils. The positions of these peaks, for soils of the same specific gravity but different gradation, appear to lie on a definite locus line.

Design of a bulkhead

One of the many uses of the chart can be illustrated by an example. In the design of a waterfront bulkhead, suppose a sand backfill is to be used, and in computing lateral pressures values must be assumed for the unit weight of the material. Either from analysis of samples of the sand, or from knowledge of similar sands, let us assume that its dry density in place will be 115 pcf. and that the specific gravity of solids is 2.65 (typical of quartz sands). Entering the left portion of the chart along the horizontal line at dry weight = 115, at the intersection with the line A corresponding to specific gravity = 2.65, several properties may be determined at a glance. It is seen that the submerged weight is 72 pcf., the porosity is about 30 percent and the voids ratio is 0.44.

How to Make the Chart

Enlargements of the chart may be easily constructed to obtain more accurate interpolations, once the principles are understood, since all lines are straight. These are defined below in terms of ordinates (dry weight) at two point on each set of lines:

Lines A—62.424 × Specific gravity at 0 porosity (left end) zero at 100 percent porosity (right end)

Lines B:—62.424 + submerged weight at 0 porosity (left end) Submerged weight at 100 percent porosity (right end)

Lines C:—Zero at value of weight in air = 62.424 (left end) 62.424 × specific gravity at intersection with line D (right end)

Line D:—Zero at zero weight in air (left end) Rising to right so that dry weight is equal to weight in air

Lines E:—Zero at zero weight in air (left end) Passing through the horizontal representing dry weight = 100 at points such that weight in air = 100 + moisture content

Lines F:—Intersection base at weight in air = 62.424 × percent saturation (left end).

Converging at right end of a particular line C

Moving to the right side of the chart along the same horizontal, at the intersection with the line C corresponding to 2.65, we find weight in air is 134 pcf., read as an abscissa. This is the saturated weight, and the maximum that might occur after heavy rains. It may be noted that for this condition, the moisture content is about 17 percent, interpolating between lines E.

For design purposes, if it is considered that 50 percent saturation of the sand above water level is a probable value, then on the same horizontal at intersection with the dotted line F corresponding to 50 percent, it is seen that the weight in air will be about 125 pcf. This value would also be obtained for a fully saturated soil whose dry weight is 100 pcf.

Volume relations from chart

The right portion can also be transformed to show volume relations instead of weight, for a given specific gravity, if the vertical scale is made to read "percent solids." This will be 100 percent at intersection of the line D and the appropriate line C. Percent water by volume may then be read from a set of lines drawn parallel to line D, which represents zero, the 100 percent water line consisting of a point located at the origin of lines C. Percent air by volume will then consist of a set of lines parallel to the chosen C line, which represents zero air, or full saturation.

Architects in Quebec Win Empty Victory

The Province of Quebec Association of Architects, which set out to restrict the activities of engineers in the field of building design and construction by taking an engineer to court charged with violating the architects' practice act, has won an empty victory, according to the July issue of the *Journal* of the Engineering Institute of Canada. A decision against the engineer in a lower court has been upheld by the Court of King's Bench, but an examination of the notes of the appeal judges, the *Journal* states, reveals that those judges held that their finding applied only to the case before them and could not be used as a precedent. The judges stated that each case of controversy between engineers and architects must be "decided on the facts at issue in each case".

The original suit was instituted by the association against a registered engineer, Byron R. Perry, for designing and supervising construction of an industrial plant. The evidence brought out in the original trial was not complimentary to the architectural profession as the man who employed Mr. Perry said he had engaged an engineer because of an unfortunate earlier experience in employing an architect to design an industrial plant.

No question of the competence of the engineer to design a safe structure was raised, and the EIC *Journal* observes that it is difficult to understand how the judges ruled against the engineer on the basis of the evidence before them. Reading the extracts from their notes reproduced in the *Journal* indicates that they did not look upon the fields of architecture and engineering as overlapping, as is now recognized in this country. On this point they said "until the legislature has made the differentiation more definite and laid down the precise limits within which the architect and the engineer are to exercise their cognate functions, the court may only endeavor, as best it may, to apply the existing statutes to the special facts submitted in a given case with a view to bringing about a reconciliation of the adverse claims. The closer the particular case approaches the more palpable the difficulty becomes".

U. S. Bureau of Reclamation photo

Fig. 1. Eight-inch layers of earth are spread and compacted to form the core section; total height will be 456 ft.

Reclamation's Biggest Earthfill Dam

D. S. Walter
Construction Engineer, Bureau of Reclamation
Anderson Dam, Idaho

***Contents in Brief**—Anderson Ranch Dam in Idaho is an earthfill structure that will contain 9,078,000 cu. yd. of material. Now nearing completion, it is already providing water storage for partial irrigation of the Boise project. Commanding attention on this tremendous earth-moving and classification job is the "pendulum" belt feeder and a trommel screen plant for processing material. Also of interest is the use of special sheepsfoot roller to permit compaction of earth close against concrete walls and thus minimize consolidation with pneumatic tampers.*

SCHEDULED for completion late this month, Anderson Ranch Dam, in Idaho, claims distinction as being the largest rolled-earth fill structure undertaken by the Bureau of Reclamation, and one of the highest dams of its type in the world. Its magnitude is indicated by these statistics: Height above foundation, 456 ft.; thickness at streambed level, 2,500 ft.; crest length, 1,400 ft.; crest width, 40 ft.; yardage of fill, 9,078,000.

The dam is a major unit of the Boise project of the Bureau of Reclamation for the comprehensive development of southwestern Idaho. Located on the South Fork of the Boise River, about 40 mi. upstream from Arrowrock Dam, it will create a 500,000 acre-ft. reservoir. This will supply supplemental water for irrigation of 320,000 acres of land, provide more than 100 million kw. hr. of power, and aid in flood control.

The reservoir is strategically located so that eventually, when facilities for exchanging water between the Payette River basin and the Boise River have been completed, water will be available for irrigating a large tract of desert land located under the proposed 400,000-acre Mountain Home project. Water diverted from the Boise River to the Mountain Home area will be replaced, as required, from surplus flows of the Payette River regulated in the Garden Valley and Cascade reservoirs, of which the latter is now under construction.

Although the dam will not be completed to full height until later this fall, 80,000 acre-ft. of storage was made available to the lands of the Boise valley during the 1946 irrigation season, and present storage will

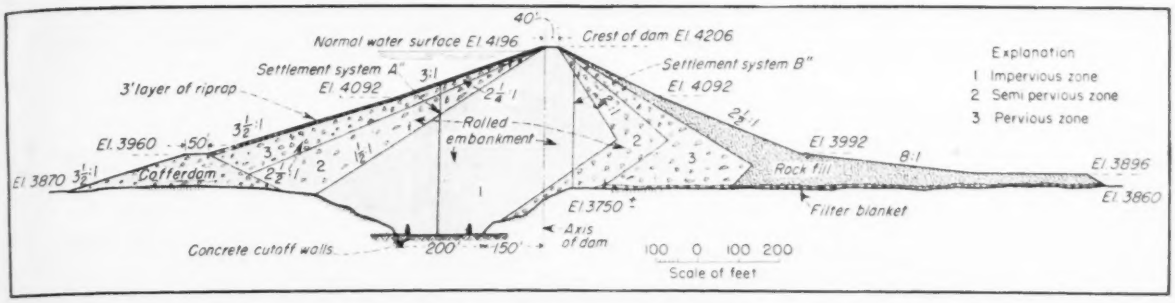


Fig. 2. Section of the dam showing zoning of the earthfill materials to produce an impervious core supported by stable, free-draining sections.

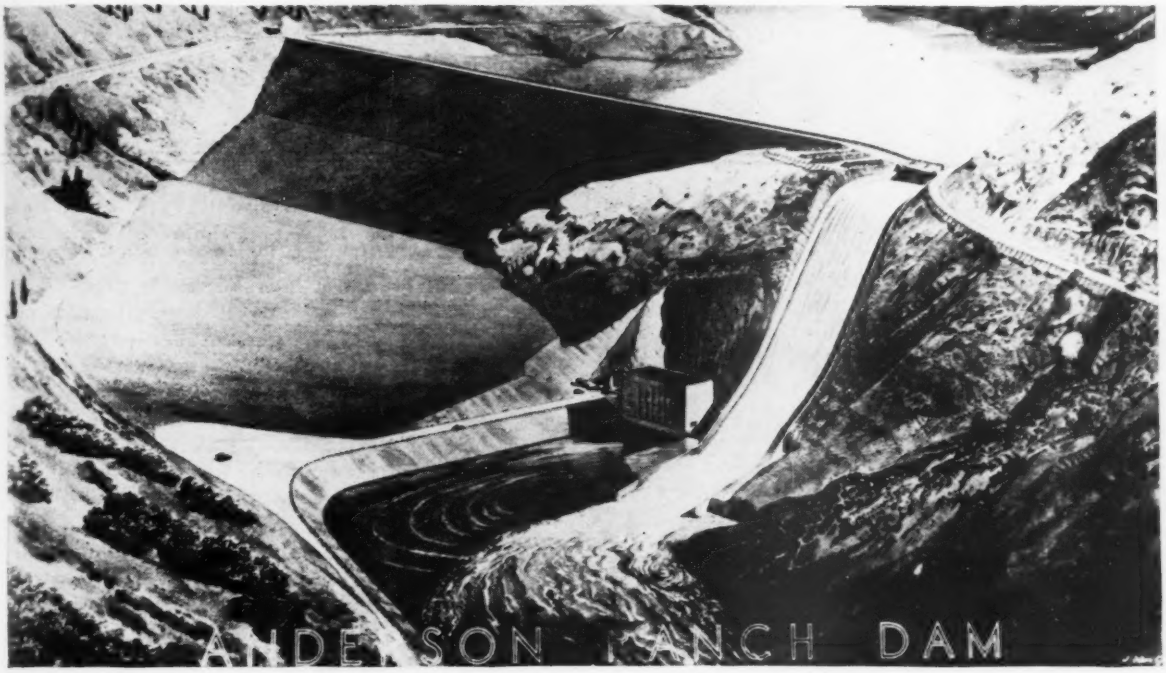


Fig. 3. Although the dam is scheduled for completion this month, the entire project as shown in this artist's sketch, which is looking upstream on the South Fork of the Boise River, will not be completed until 1949.

provide 130,000 acre-ft. for use during the year 1947.

During early stages of construction, the river was diverted around the dam site by means of a 20-ft.-diameter concrete-lined diversion tunnel. In December 1945, flow through the tunnel was discontinued by closing a flap gate at the upstream portal. The diversion tunnel was then plugged solid with concrete for a distance of 80 ft. upstream from its intersection with the inlet tunnel.

Outlet and control works

Release of water from the reservoir has been controlled by an emergency fixed-wheel gate installed in the permanent inlet structure of the outlet works. This structure consists of an inclined inlet tunnel leading into the diversion tunnel, fitted with a sloping trashrack. As the emergency fixed-wheel gate, which is operated on rails embedded in the sloping floor of the inclined trashrack, was designed to operate under unbalanced heads not to exceed 100 ft., present storage in the reservoir is consequently limited to a maximum of 130,000 acre-ft.

Penstock pipe with an inside diameter of 15 ft. will be installed in the outlet tunnel to serve the three units in the power plant as well as a battery of five 72-in. outlet pipes, which will be controlled by hollow-jet valves having a total capacity of 10,000 second-feet. These outlets will regulate the reservoir level and downstream river flow, and during periods of flood flow they will be used to supplement spillway discharge. After the outlet valves are in operation the inclined inlet tunnel will then be a pressure tunnel, and the fixed-wheel gate will be operable under full reservoir head for emergency use.

The spillway, designed for a maximum discharge of 20,000 sec.-ft., is located at the left abutment. It is a concrete-lined open-channel type structure with discharge into a stilling basin at the lower end. Control will be accomplished by two 25 by 22-ft. radial gates mounted to seat on a low ogee section at the entrance. The spillway and outlet works constitute a combination structure in which the spillway flow will shoot over the openings for the outlet valves and

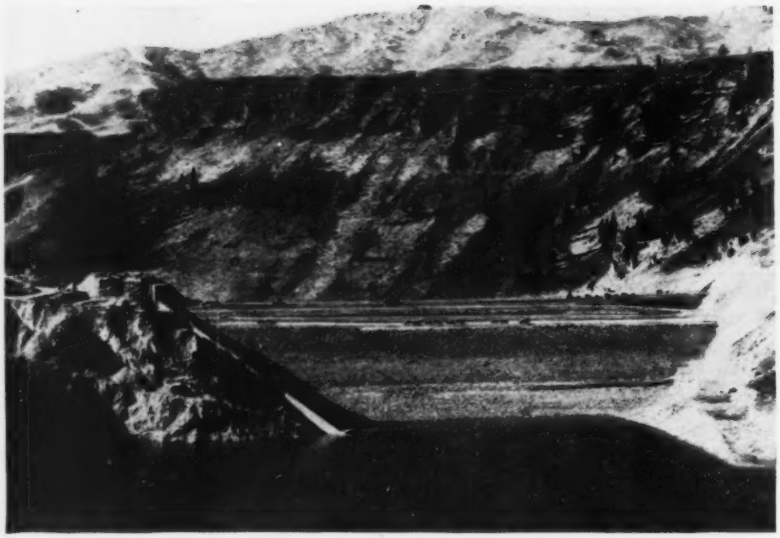


Fig. 4. Upstream face of the dam showing reservoir at minimum water surface. The inclined trash rack of the outlet works is shown at the left center.

plunge into a stilling basin a short distance downstream. The outlet valves will discharge under the spillway flow and into the same stilling basin.

The power plant of reinforced concrete construction is at the right and adjacent to the spillway. It will house two 15,000 kva. generators driven by 21,000 hp. turbines, with provisions for the installation of a third unit at some later date. The power plant is designed to be operated in conjunction with the present Black Canyon and Boise diversion power plants on the Boise project, and will assist in relieving power shortages in the Minidoka project.

Although construction of the dam and appurtenant structures was started in August of 1941, with the completion date scheduled for April 1946, numerous delays, caused mainly by the war and reduced appropriations, have retarded progress. The present construction program contemplates completion of the dam in September with progress on other phases of the project accelerated to the extent necessary to provide full reservoir storage and the generation of power in 1949.

Geological conditions at site

Investigations at the dam site revealed the foundation to be composed of igneous rock of several varieties, mainly granite, cut by numerous dikes or vein-like masses of dioritic and pegmatitic rock. The texture of the granite is medium- to coarse-grained, consisting predominantly of quartz and orthoclase feldspar, traversed by a complex system of shear planes and joints varying from one to several feet apart. Separation at these joints is usually small, with the openings filled with clay-like material, ranging from mere films to one-half inch in thickness.

With the exception of the rock at the left abutment, the bulk of the granite exposed in the dam foundation was found to be fairly hard with narrow zones of sheeted and weathered rock. Although many of these zones extended to depths of 150 ft. or more below the foundation, they were considered of little importance because they were relatively water-tight and surrounded by harder rock. This, however, was not the case at the left abutment where the exposed granite was generally shattered and weathered to great depths, as revealed by horizontal drifts driven into the canyon wall.

Although excavation for the left abutment removed all loose and unstable material to provide a suitable foundation for the dam, excavation for the spillway channel caused slides to develop in the granite hillside above roadway level. Because of this potential hazard in relation to the spillway, the slopes were flattened to the extent necessary for permanent stability. Fortunately, the material involved was ideal and economical for use in the dam embankment, and consequently was designated as a borrow area. Some 1,700,000 cu. yd. of material, consisting mainly of disintegrated granite, was thus made available.

How geology affected design

The jointed and disintegrated condition of the granite foundation was one of the deciding factors in designing the dam as an earth fill, rather than a concrete structure.

The body of the dam is a rolled embankment, zoned to produce an impervious core section, supported upstream and downstream by stable semipervious and pervious sections grading in coarseness toward the outer slopes. The upstream face is protected against wave action by a 3-ft. layer of riprap. A heavy rock fill underlaid by a 6-ft. sand and gravel filter blanket is provided on the downstream slope. The dam was designed to make effective use of materials from required excavations.

To prevent seepage under the dam, a cut-off trench 200 ft. wide was excavated to sound bedrock through 125 ft. of river fill. Two concrete cut-offs, consisting of walls varying in height from 5 to 18 ft. with footings extending from 3 to 5 ft. into undisturbed bed-rock, were constructed across the bottom of the foundation and up both abutments.

To further reduce seepage through the foundation rock, grout curtains extending to a maximum depth of 150 ft., with holes spaced at 10-ft. or less centers, were provided under the concrete cut-off walls. The surface rock between these walls was blanket-grouted with 20 to 30-ft. holes on about 20-ft. centers. At the left abutment, long holes from the diversion tunnel were drilled and grouted to augment the grout curtains under the cut-off walls.

Handling the impervious material

Impervious material for constructing the Zone 1 or core sections is obtained from the so-called Dixie borrow area. This deposit is located on a high flat about 1½ mi. downstream from the dam.

The material consists of a sandy clay, with an average of 95 percent passing a ¼-in. screen and 33 percent passing the 200-mesh screen. With

standard compaction it has an average dry density of 119 lb. per cu. ft. at an optimum moisture content of 12.7 percent of dry weight. The average percolation rate is 0.048 feet per year under a unit gradient. Gradation of the deposit is unusually uniform, with a moisture content averaging about one percent dryer than optimum.

The material contained in the Dixie deposit was readily excavated with two 5-cu. yd. electric shovels and loaded into a "pendulum" belt feeder of 150-ft. span, which discharged onto a belt conveyor for transportation to the dam. At the close of the 1946 season, with the bulk of the embankment in place, it was decided that the remaining material required from this source could be handled more economically by truck haul.

The hopper of the pendulum was designed to allow simultaneous loading with the two shovels and was equipped with a chain-type pan feeder which served as the hopper floor. Material was discharged through an adjustable gate opening against revolving teeth on a chopper roll to reduce oversize material to less than 6 in. At the transfer end, 150 ft. away, the material dropped onto two 30-in.-dia. feeding rolls set parallel to the 42-in. field conveyor belt. Caterpillar tracks, electrically powered, were used to move the transfer end along the field belt, or to move the entire pendulum to a new working position; the hopper end was moved by either shovel.

Material was transported over the 42-in. field belt to the 36-in. main belt conveyor system, which was 9,630 ft. long and traveled at a rate of 550 fpm. The pendulum was designed to handle up to 1,000 cu. yd. an hour, but was held to a maximum of 870 yards to avoid overloading the main conveyor belt.

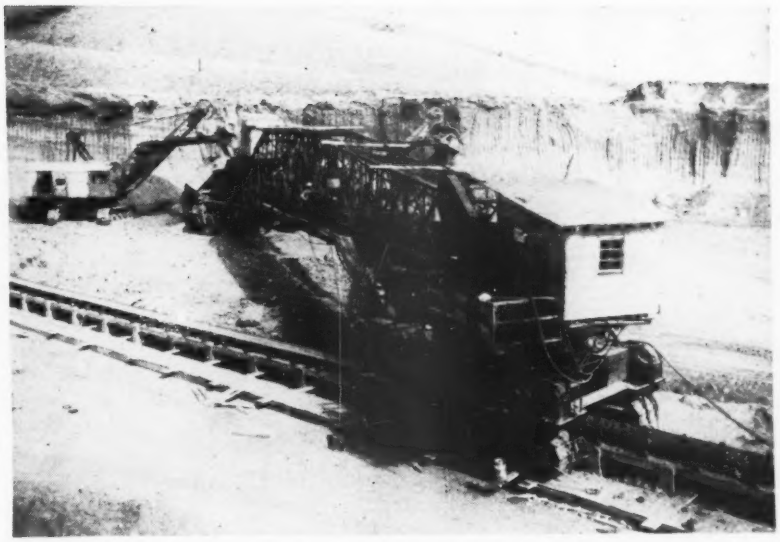


Fig. 5. Pendulum feeder which was used to load clay material on belt conveyor for transport to the dam site. Flexibility of this rig, which was loaded by electric shovels, permitted excavation of pit 30 ft. above and below the conveyor belt.

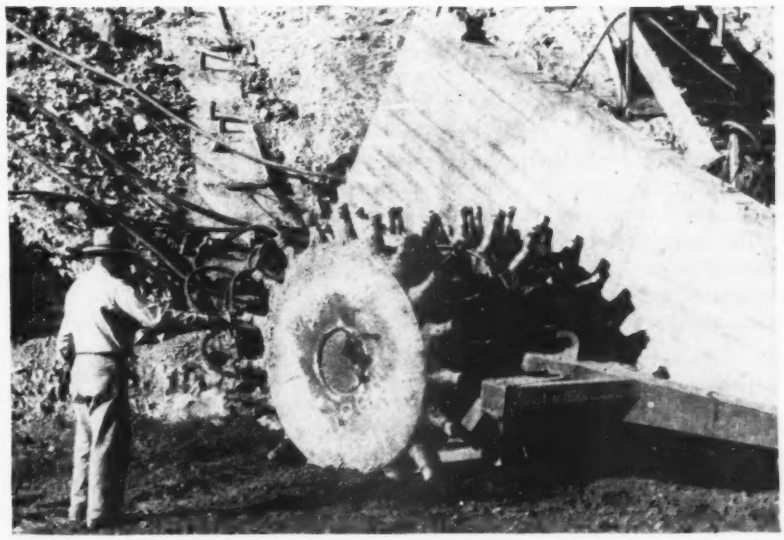


Fig. 6. Compaction of impervious material adjacent to abutments and around cutoff walls was accomplished with narrow-drum, frameless roller designed and constructed on the job. Absence of framework and special design of tamper heads permit compaction of material within a few inches of walls, thus reducing the size of areas to be consolidated by pneumatic tampers.

Getting out the pervious materials

Prior to the 1946 construction season, semi-pervious and pervious materials for use in the Zone 2 and Zone 3 sections of the embankment were obtained from a borrow area located immediately upstream from the dam. This deposit consisted of alluvial strata of sand and gravel some 50 ft. in depth, with a capping of torrential outwash of large basalt boulders and silty clay varying in depth from 5 ft. adjacent to the river up to 45 ft. near the upper limits of the deposit.

Excavation of the deposit was made with three separate shovel cuts. The lower cut yielded sand and gravel, which could be placed directly in the Zone 3 or pervious section of the embankment. The middle cut yielded a mixture of sand and gravel, with a sufficient quantity of silty clay to produce semipervious material after processing. The upper cut, after processing, yielded impervious material, which was placed in the core section of the dam.

Bottom-dump trucks, loaded by two or more shovels of 2½-yd. capacity, transported the excavated material from the lower cut directly to the pervious section of the embankment; end-dump trucks were used to handle the material from the upper cuts to the screening plant for processing.

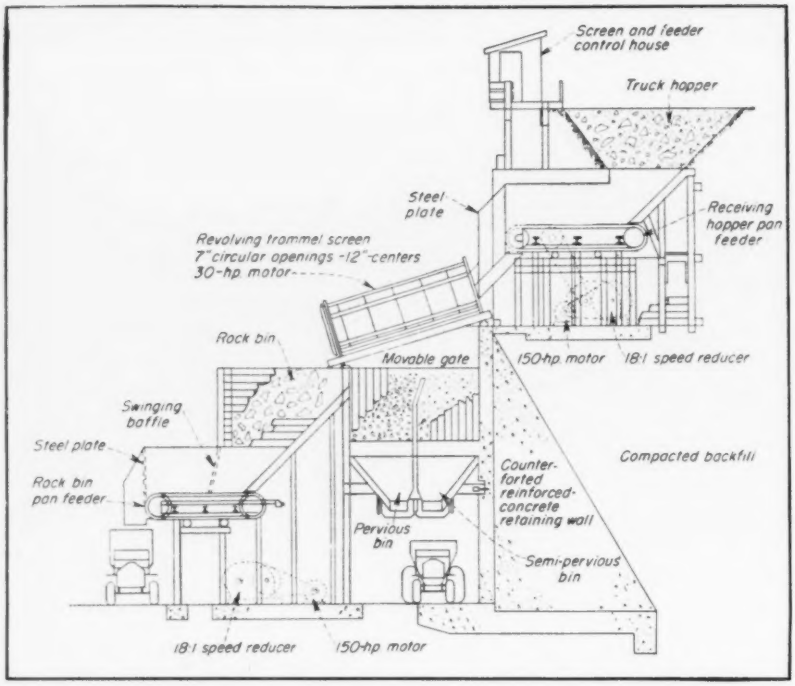


Fig. 7. Details of the processing plant for the screening of material prior to placement in the embankment. Fine and coarse material are segregated in separate bins; rock is discharged at the end of the trommel screen.

This plant removed all rock in excess of 5 in. for later use in the riprap and rock-fill sections of the dam.

The start of reservoir storage in December of 1945, necessitated the location of a new source for this type of material.

Earth slides provide fill

As previously mentioned, major slides at the left abutment of the dam above the spillway channel required the removal of a great quantity of material in order to insure permanent stability. Although some 500,000 cu. yd. of material were removed from the hillside during 1942 and 1943 in an effort to stabilize the slope, a new slide of major proportions occurred on July 6, 1945. The final slope was designed so that the remaining requirements for semipervious and pervious material could be obtained for completion of the embankment, including the requirement for a large quantity of rock needed to complete the rock-fill section.

During the winter of 1945-1946, four exploratory holes were diamond-drilled to a depth of 100 ft. in the major slide area, revealing the presence of an extensive clay seam varying in thickness up to 4 ft. The steeply-sloping clay seam appeared to roughly parallel the original ground surface and was believed to be the slip plane on which the overlying granite had been sliding. These exploratory holes also revealed that the disintegrated granite above the clay seam was badly shattered, but below the seam it was fairly hard, showing no apparent signs of movement. The existence of the clay seam was carefully considered in establishing the limits of borrow excavation, so that the permanently exposed rock slope would be in firm and undisturbed granite, well beneath the objectionable clay seam.

From the top of the borrow-excavation cut at El. 4,675, the final slope is approximately 1:1 down to El. 4,400, where a 20-ft.-wide berm is provided for safety against rolling rocks. Below this berm, the slope is flattened to approximately 2:1 down to the bottom of the cut at El. 4,206, which is the roadway level of the dam.

Excavation is accomplished with one 5-yd. electric shovel and several 2½-yd. diesel-operated shovels, working on benches. The excavated material is transported to the left abutment processing plant in end-dump trucks of 8-yd. capacity. The loose and shattered material overlying the clay seam is readily excavated without the use of powder, but the harder granite below the seam requires blasting.

Slide material is screened

Practically all material excavated from the left abutment slide area requires processing through a screening plant prior to placement in the embankment. This plant, located 1,000 ft. upstream from the axis of the dam, has performed exceptionally well with lost-time resulting from plant breakdowns amounting to less than 2 percent during 1946. Designed to handle 900 yd. of material per hour, the plant attained a maximum hourly production of 831 yd. during one shift, with a season average of 410 yd. per operating hour.

The receiving hopper of the plant is constructed of steel and is located directly over a pan feeder, which conveys the raw material into a short steel chute with a discharge directly into a trommel screen. The hopper has a working capacity of 90 yd. and can accommodate four trucks dumping simultaneously. One of the outstanding features of the plant is that it permits stockpiling of raw material adjacent to the receiving hopper during the time the plant is shut-down for repairs. When plant operations are again resumed, stockpiled material is bulldozed into the receiving hopper, while at the same time additional material is being hauled from the excavation and dumped directly into the same hopper. Because of this feature, the plant can be operated on a 2-shift per day basis while excavation operations are being carried on continuously.

The trommel screen, 6 ft. in diameter and 25 ft. long, is set on a slope of 3½:1 directly over a 16-ft.-wide by 20-ft.-long bin. In this bin, which is divided by a partition into two compartments, the semipervious and pervious materials are collected. As the raw material passes through the screen, fine material drops into the first compartment, while the coarser material is deposited into the second compartment. A movable gate, hinged to the top of the dividing partition, can be adjusted to facilitate selection of materials.

The processed material is dis-

charged into bottom-dump trucks through two openings in the bottom of each compartment, controlled by air-operated roller flap gates. Oversize material falls directly into a rock bin where a pan feeder discharges the rock into end-dump trucks.

The two pan feeders mentioned were constructed on the job mainly from caterpillar-track parts. Designed to travel 20 fpm., this type of feeder has proven to be exceptionally efficient and economical.

From a control house at the upper level of the plant an operator controls the receiving hopper feeder, trommel screen, and a system of lights indicating to the truck drivers the correct bin to load under. Another control point is located at the lower plant level from which an operator directs the loading of all trucks.

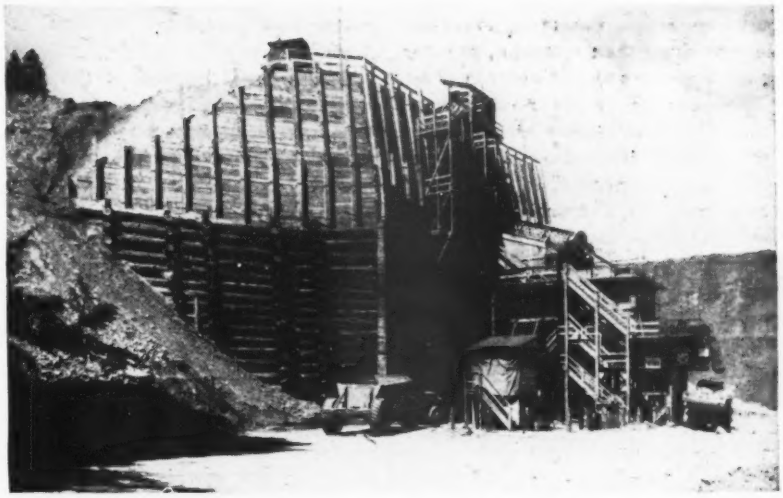


Fig. 8 Processing plant is located on the left abutment of the dam, which made it convenient to receive material and discharge it by gravity for transportation. Maximum hourly production was 831 cu.

Rock for rip-rap and veneer

Basalt rock is used for the 3-ft. layer of riprap on the upstream face of the dam, and as a protective veneer on the downstream slope. Prior to 1946, the required rock was obtained from the processing plant. After the inundation of this area by the reservoir, the remaining rock for facing was obtained from a heavy talus slope near Elk Creek, about one-half mile upstream from the dam on the right side of the canyon. In addition to the indication of a substantial volume of loose rock in the talus slope at this location, the cliffs above were situated favorably to produce any additional rock required by means of a "coyote" shot.

When it became evident that a sufficient quantity of loose rock was not available in the talus slope to complete the dam, two 3 by 5-ft. tunnels, located 80 ft. apart, were driven into the rock face above the talus slope for a distance of 70 ft. Right-angle drifts excavated at the end of each way, provided four slightly enlarged pockets for holding the explosives. Each of these pockets was packed tightly with bag powder, after which the tunnels were stemmed with tunnel muck, carefully sacked during excavation and stored outside the portals. The resulting blast produced about 100,000 yd. of broken basalt to fill the remaining requirements for this type of material.

Excavation of rock from the Elk Creek borrow area is accomplished with one 2½-yd. diesel shovel with transportation to the dam in trucks of 8-yd. capacity. The original talus deposit consisted of fairly uniformly graded boulders and fragments, with occasional pockets of silty clay that were wasted at the pit. However, the rock resulting from the blast was more coarsely graded and required some blasting of the larger blocks to permit loading with the shovel.

Dam foundation preparation

Stripping of the abutments and excavation for the dam foundation were performed by conventional truck and shovel methods. Removal of the 630,000 yd. of material from the cut-off trench was started immediately following river diversion and was completed to bedrock in 110 days. This phase of the work was facilitated by the small quantity of water encountered below streambed level.

Preparation of rock foundations under the impervious portion of the embankment was done with special care, particularly in the area between cut-off walls and for a distance of 25 ft. outside these walls, where the sound bedrock was cleaned thoroughly with high-pressure air jets prior to placement and compaction of impervious material. Excavation and preparation of foundations in overburden materials under the coarser zones of the dam were also made with care, but with the purpose in mind of providing foundations equal in density and stability to the superimposed material in the dam. The foundation under the rock-fill section was prepared by leveling and rolling prior to placement of the 6-ft.-thick filter blanket.

Material for the filter blanket, consisting of a free-draining mixture of coarsely-graded sand and gravel, was placed in continuous horizontal layers not more than 12 in. thick. Immediately after the placing, each layer was thoroughly saturated by sprinkling and compacted evenly by truck travel.

Placing impervious material

The impervious material, after reaching the end of the conveyor system, discharged over the left abutment to form stock-pile from which one 5-yd. electric shovel loaded the material into trucks for distribution in the core, or Zone 1, section of the embankment. The trucks, of 14-yd. capacity, deposited the clay in windrows parallel to the axis of the dam. After spreading to a uniform thickness of about 8 in. with bulldozer-equipped tractors, each layer was rolled twelve times with sheepsfoot rollers to produce compacted layers of 6-in. thickness.

In areas adjacent to the abutments and around the cut-off walls, compaction was obtained by means of a specially-constructed narrow roller, supplemented by pneumatic tampers.

Although the moisture content of the clay was usually ideal for rolling

and compaction, averaging about one percent dryer than optimum, at times it was necessary to add water in order to produce the proper moisture content. This was readily accomplished by sprays attached to the discharge end of the conveyor, supplemented occasionally by a stream of water injected into the material as it flowed from the end of the belt. In this manner, moisture was evenly distributed throughout the material.

In order to obtain maximum bond between layers, the hard surface crust caused by truck travel was broken up effectively with a scarifier and moistened by sprinkling immediately before the succeeding layer was placed.

The bureau-designed sheepsfoot rollers have given excellent results in compacting the impervious and semi-pervious embankment materials. Although roller maintenance was a serious problem during the early stages of construction, due mainly to the abrasive action of the borrow material, this difficulty has been corrected to a large extent by welding hard facing material (Tube Borium or Raynite welding rod) on the taper heads and shanks. Metal ballast, used in lieu of sand and water to bring the total weight of each double-drum roller up to 20 tons, not only reduced bearing wear but also resulted in other operational advantages.

Placing semi-pervious materials

The semi-pervious materials were placed in the Zone 2 sections of the embankment in 8-in. layers and compacted to 6-in. thickness by twelve passes with sheepsfoot rollers. The methods used were identical to those used in the core section except that scarifying the surface of layers was unnecessary as the material did not crust with truck travel, and readily absorbed the tempering water applied by truck sprinklers.

The pervious material in the Zone 3 sections of the embankment was placed in 12-in. layers and compacted by sluicing, supplemented by truck travel. Sluicing operations were performed as soon as practicable after the material was spread, using water jets from high-pressure fire hose. The equipment was then routed over the saturated layer to produce maximum compaction. This, of course, was done before the sluicing water had percolated through the layer.

The rock-fill portion of the dam, composed of rock fragments, boulders, and cobbles from required rock excavation and borrow areas, was placed dry in horizontal layers. A dragline was used for smoothing the rock to finish grade, and for broadcasting selected loads of smaller rock on the surface to fill in the larger voids and give the slope a pleasing appearance. The 3-ft. layer of riprap composed of basalt boulders ranging from one-half cubic foot to one-half cubic yard in volume, will provide adequate protection against wave action at the upstream face of the dam.

Settlement being studied

Settlement apparatus and piezometers are installed in the embankment to determine the actual behavior of the materials both during construction and after the dam is completed.

Apparatus installed at two locations provides means of measuring foundation settlement and embankment consolidation. Each installation consists of telescoping 1½-in. and 2-in. pipes, with every other 1½-in. pipe section anchored to the embankment with a 3-ft. cross-arm. These cross arms are 5 ft. apart vertically and each moves independently of the rest of the system.

Pressures developed within the dam are determined by means of piezometers installed at various locations in the embankment. Plastic tubing extends from each piezometer tip to a terminal well located near the downstream toe of the dam. As the tubes are filled with liquid, pressures developed in the embankment are transmitted through them from the tips to a gage at the terminal well.

Direction and execution

Anderson Ranch Dam is a comprehensive unit of the Boise project being constructed by the U. S. Bureau of Reclamation under the administrative guidance of R. J. Newell, regional director, Boise, Idaho. Design and construction are under the technical supervision of Walker R. Young, chief engineer of the bureau. The bureau is a branch of the U. S. Department of the Interior, of which J. A. Krug is Secretary. Michael W. Straus is Commissioner of Reclamation, and has his headquarters in Washington, D. C.

Construction of the dam and appurtenant structures is being performed by the Morrison-Shea-Twaits-Winston Co., under the field direction of Charles S. Bradley, assisted by John Erdle, job engineer. Fabrication of penstock and outlet pipes is under contract with Southwest Welding and Manufacturing Co. of Alhambra, Calif.

City-Owned Utilities Report Revenue Rise

Revenues from city-owned utilities in Kansas jumped 37 percent in the last five years, according to the American Municipal Association.

Citing a survey just published in the Kansas Government Journal of city-owned waterworks, gas systems, electric distribution, and electric generating plants and distribution systems, the association stated that while total revenues rose from $12,956,000 in 1941 to $17,731,000 in 1946, the valuation of city-owned utilities increased 13 percent.

An overall summary shows utility consumption increased from 26 to 58 percent from 1941 to 1946. During this period the number of Kansas consumers served by these utilities increased only 5 to 10 percent.

City-owned waterworks—Number of consumers increased 10 percent while water consumption increased 26 percent and water revenue increased 31 percent.

City-owned gas systems—Number of consumers increased 7 percent while gas consumption increased 27 percent and gas revenue increased 36 percent.

City-owned electric distribution systems—Number of consumers increased 5 percent while consumption increased 58 percent and revenue increased 31 percent.

City-owned electric generating and distribution systems—Number of consumers increased 9 percent while consumption increased 39 percent and revenue increased 41 percent.

The 1946 survey of the Kansas Government Journal covered 364 city-owned waterworks, 18 gas systems, 65 electric distribution systems, and 70 electric generating and distribution systems.

Compressed Air To Prevent Freezing In Open-Air Filter Plant Units

Compressed air bubbling through water in sedimentation tanks and rapid sand filters is expected to prevent freezing in a 6-mgd. water filtration plant being installed at Pasco, Wash. Designers of this plant hope that this system will eliminate the need for enclosing these units to escape damage from severe winter weather. Air capacity of some 30 cfm. at 5 psi. is being provided by means of a 5 hp. compressor for the protection of the two 34x125 ft. sedimentation basins and the four rapid sand filters.

The design was based on experience gained in Milwaukee, Wisc., where for a number of years water in several lakes in city parks has been kept relatively free from ice even during prolonged cold snaps where the temperature went as low as minus 15 deg. F. The purpose in Milwaukee was to protect ducks and other wild-life from becoming caught by the quickly frozen water.

Thermostatic control

In the Pasco plant, air will be delivered through ½- and ¾-in. pipe set around a perimeter of the units. These pipes will have 1/32-in. perforations spaced 1 in. apart. The air pipes will be set near the bottom of the sedimentation basin and just above the sand level in the filter units.

A thermostatic control will turn on the compressor when the outside air temperature falls below the freezing point. Experience may prove that some lower temperature is permissible. However, it is believed the water will freeze quickly when exposed to sub-freezing temperatures as it is taken directly from the Columbia River which is only a few degrees above freezing the year around.

Although the Milwaukee experience indicates this scheme will work, its success is not assured in filter plant installations the designers caution. However, it is believed worth a try because the equipment required is relatively inexpensive as compared with the cost of housing the units. Besides this, winter weather in Pasco is normally not very severe; a heavy freeze that could damage the new plant being expected about one year in five.

Two-stage sedimentation

A design feature of the Pasco plant is a small pre-sedimentation unit to remove the larger pieces of floc before the main basin is reached. This 20x50-ft. unit has mechanical scrapers and is located just after the mixing basins. It will permit the operation of the main units or coagulation basins for a longer period of time between shutdowns for manual cleaning. The two-stage sedimentation system will assure the removal of a major part of the river sand and silt that is in suspension in the water.

Briefly, the process at Pasco is as follows: Water first flows through a flash mixing basin where alum is added and then through two slow mixing basisns equipped with paddles on vertical shafts. The rest of the plant consists of the 20x50-ft. pre-sedimentation basin, the two 34x125-ft. coagulation basins and four rapid sand filters. Provision is made for either a pre- or post-chlorination.

A contract for the construction of the buildings required is held by James Construction Co. of Seattle and a subsequent contract for the installation of equipment and pumps is expected to be let this fall.

John C. Cunningham and associates Portland, Ore., designed the plant for the city of Pasco.

Many Cities Open Off-Street Parking Lots

Sixty-five cities last year opened new off-street parking facilities to reduce downtown traffic congestion according to the International City Managers' Association.

Information gathered for the 1947 Municipal Yearbook further reveals that a total of 345 cities out of 875 reporting now have one or more off-street parking lots in operation,—a 63 percent increase over 1942 when only 211 cities operated municipal off-street parking facilities.

Four cities spent more than $50,000 each on new municipal parking lots last year—Eau Claire, Wis.; Miami Beach, Fla.; White Plains, N. Y.; and North Adams, Mass. Cleveland, Anaheim, Cal.; Greensburg, Pa.; and Winnetka, Ill. each made capital outlays of from $10,000 to $50,000 for parking facilities.

Miami to spend $300,000

Miami Beach, Fla., voted a $300,000 bond issue for off-street parking and in addition used $73,733 from tax revenues to establish parking lots. In California, the City of Whittier purchased five off-street parking lots from the proceeds of 300 parking meters installed in 1945.

St. Petersburg, Fla., which opened two lots totalling 1,100 cars capacity, set the record last year for area-expansion of municipal parking facilities. Costs of the lots were a moderate $8,000.

An average of two lots is operated by each of the 345 cities over 10,000 population reporting publicly-owned facilities. The largest publicly-owned and operated parking lots in the country are those run by the Chicago Park District, holding more than 5,000 autos.

Fewer than 20 cities charge autoists for parking. Rates vary from 10c. per day in Akron to 35c. for 24 hrs. in Chicago. Miami Beach and several other cities have installed parking meters in their lots. About 35 cities throughout the country have placed two-to-four hour limits on parking in city-owned lots.

To relieve congestion, the City Planning Commission of Columbus, Ohio, has made a proposal for the construction of a $2,000,000 parking center which would provide space for 4,000 cars. This would be built underneath the lawn of the state house. At Pittsburgh, Pa., the city's new Parking Authority has announced that its first parking facility may be in operation next year.

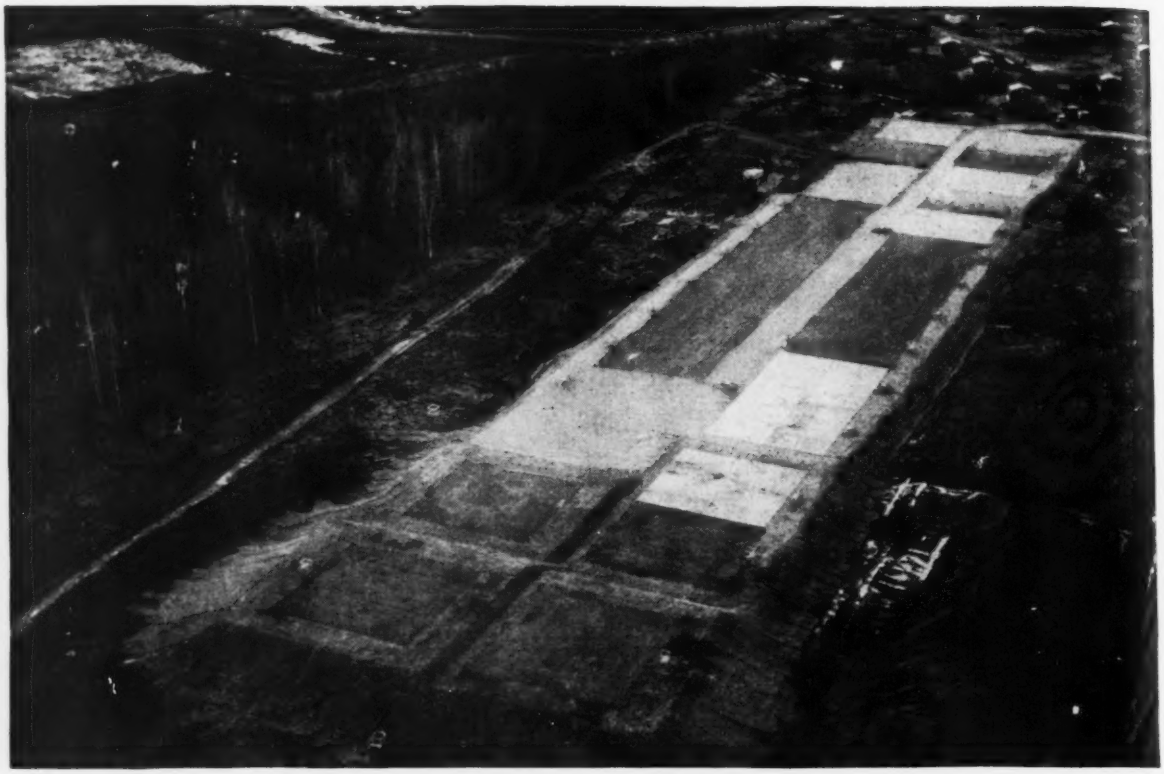


Fig. 1. Test structure for runway foundation experiments at the Fairbanks, Alaska, permafrost test field.

A Test Study of Foundation Design For Permafrost Conditions

Contents in Brief—*Permafrost, or permanently frozen, ground is widely destructive of engineering works throughout Alaska. Army engineers have begun a test study of foundation design for permafrost conditions with an extensive field testing station at Fairbanks, Alaska. Airplane surveys of Alaskan terrain and laboratory studies in the United States are being employed to supplement the field tests.*

INTENSIVE TESTS to determine stable foundation types for buildings and other structures in permafrost regions are being conducted by the Corps of Engineers, U. S. Army. The work was prompted by disastrous happenings to roads, runways and buildings constructed in Alaska for war operations. Some 500 miles of the Alaskan highway had to be relocated, many airport runways rebuilt and sagging buildings straightened up because of settling foundations due to permafrost. A fundamental remedy had to be worked out, and to find it a definite research program was started in 1945. The work is of special interest.

A study of permafrost is unique in the history of American engineering research. Present military needs are those of least importance. A successful determination of foundation security is necessary for an economic development of roads, railways, city public works and private building in Alaska.

Permafrost problems are nothing new. They have been a prominent and vital consideration since major engineering construction has been undertaken in Alaska and other frigid regions. Russian engineers have had long experience with them in Siberia (*ENR* Nov. 28, 1946). How serious they may be is outside of most foundation experience, however, and calls for brief explanation. Permanently frozen ground, permafrost, is a condition over most of Alaska. The frost depth varies from nothing on the southern border to a so far determined depth of 960 ft. south of Point Barrow. Permafrost exists where winters are long and cold, where summers are short, dry and relatively cold and where precipitation is scarce during the year.

The upper limit of permafrost is referred to as the permafrost table.

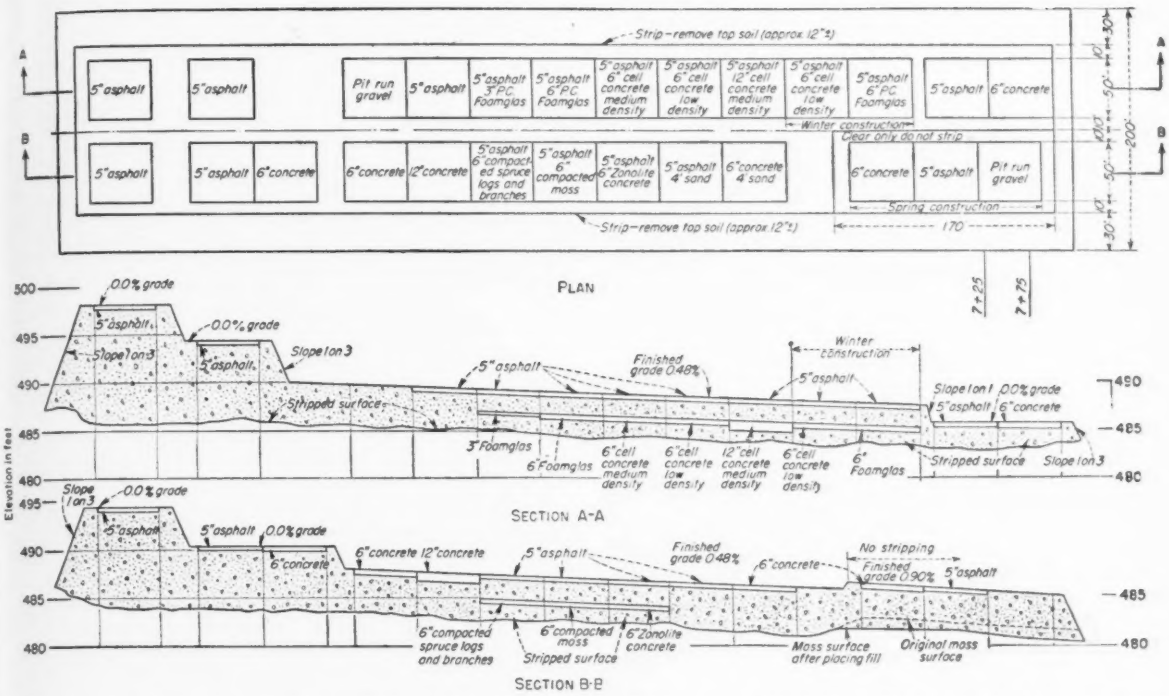


Fig. 2. Details of the 26 runway foundations on permafrost under test at Fairbanks test field shown on opposite page.

It is variable in depth from the surface but remains relatively constant at any point unless the natural surface is disturbed. The layer above the permafrost table is known as the active layer. This is the few surface feet that freeze and thaw with the change in seasons. If the soil is coarse grained well-drained material, no heaving takes place during seasonal freeze and thaw. However, if it is of fine-grained material the effect of heaving and settlement can be disastrous. There are many variations of ground movement—creeping, sliding, shrinking, cracking, heaving and settling—all of which may occur in many combinations and gradations. Coupled with these conditions of soil movement is the fact that underlying permafrost prevents any subterranean drainage and surface ditches fill with mud.

Normally, the permafrost table remains at constant level during the seasonal thawing and freezing of the active layer. The natural vegetation in Alaska acts as insulation to preserve this condition. When the protecting vegetation is removed for construction, thawing temperature in the active layer penetrates deeper and the permafrost begins to thaw and, if fine material, to become unstable. If a thawing temperature continues, as under a heated building, thawing continues, causing a progressive recession of the permafrost table.

Research inaugurated

While in general the facts outlined were known to engineers with Alaskan experience it required the heavy operations of military road building, and airfield runways and buildings to impress their economic significance. The costly relocation of the Alaskan highway in 1943, a year after construction, has already been noted. Also within a year after construction, runways at Northway Airfield had to be completely dug out and the excavated area back-filled with coarse material. Keeping adequate foundations under large heated buildings was even more difficult a problem than runways since the heat constantly

Fig. 3. Section of runway test area showing several types of insulation in place. In the right foreground is "Zonolite" concrete, in the left foreground is moss and spruce boughs, in the back section is "Foamglas" in place. Additional blocks of "Foamglas" are stacked at extreme right.

Fig. 4. Construction operations and hindrances in placing "Foamglass" and "cell concrete" insulation March 24, 1947. (1) Sealing joints in 6-in. layer of "Foamglas" with tar. (2) Sealed layer of "foamglass" receiving cover of runway base material. (3) Spring snowfall blankets "cell concrete" with joints open. (4) Melting ice from joints of "cell concrete" with weed burner.

thawed the underlying permafrost to greater depths. Cumulative troubles dictated a purposeful search for cause and remedy.

After some preliminary study, a separate research organization was set up at the U. S. district-engineer office at St. Paul, Minn. in 1945. The investigation is now well under way with 20 employees in the field at Fairbanks, Alaska, and 10 at the St. Paul headquarters. Research to determine thermal properties of soils and insulating materials is being conducted at the University of Minnesota and the air-photo reconnaissance phase of the work is being done with the assistance of Purdue University. Besides this direct experimental work observations are in progress at existing airfields to record movements of the permafrost table, fluctuations of groundwater, runway and building settlement, soil characteristics and other action or conditions affecting permafrost foundations. Only the direct field testing program is described here.

The objectives of the tests are: (1) to find the best methods to be used on various types of soils in constructing airports and airport structures, buildings of all types and utilities; (2) to determine whether surface vegetation should be removed or left undisturbed; (3) to discover the best type of insulating material to assure a stable foundation; (4) to determine the depth piling should be placed in permafrost to prevent failure of structures, and (5) to ascertain the value of air-photo studies in selecting construction sites.

At first thought it would seem that the last objective numbered should be the most visionary of practical attainment but the survey operations are already paying off. Many terrain features easily recognized from air-photographs offer valuable clues to the presence or absence of permafrost. Ridge lines, drainage patterns, flood plains, ground slopes and other topographical characteristics serve as dependable guides to likely construction sites. Tree species also offer clues to soil types and conditions. For example birch usually indicates unfrozen ground; spruce, wet ground and a high permafrost table; willow presence of underground water; pine and fir, well drained, granular soils, low permafrost or none at all.

Construction of the field test areas was completed in June, 1947, and observations are now being recorded. The testing ground is near Fairbanks on an area of fine-grained soil with a permafrost table only 3 or 4 ft. below the surface. The illustrations show the topography and natural growth. The area is in three divisions.

Division 1 is being used to observe the effects of solar radiation and climatic conditions such as wind velocity, humidity, air temperature and precipitation. One part is left in its natural state, one has been cleared of brush and trees but not stripped, and the third has been stripped to a depth of 12 in. Each section has its temperature measuring instruments, vertical-movement observation points

and groundwater wells. For solar radiation observations there are three 30-ft. square 6-in. concrete slabs, one painted white, one painted black and one left the natural concrete color. Automatic temperature recording apparatus in each slab will determine the effect of color on heat transfer into the ground.

Division 2 of the test area is used for runway studies. Fig. 1 is an airplane view and Fig. 2 gives the general construction details. The test structure is two rows of runway slabs 50x50 ft. with a temperature well in the center of each. The depth of the base course, as shown by Fig. 2, varies from 2 ft. to 12 ft. The pavements are concrete, asphalt and gravel. Under several of the slabs a layer of insulating material is inserted 2 ft. deep in the base course. The insulation used was moss, spruce boughs, "Foamglas", "Zonolite" (expanded vermiculite) concrete and "cell concrete." Cell concrete is made in a special mixer using a foam compound which causes air bubbles to form in the concrete making it light and an excellent insulator.

Fig. 3 shows various kinds of the insulators being placed. The views grouped in Fig. 4 show operations in placing "Foamglas" and "cell concrete", with an indication of the climatic conditions. Figs. 2 to 4 indicate all essentials of runway test structure and construction.

Division 3 is being used to test different types of foundations under heated buildings. Eight 16x16 ft. buildings of the type shown by Fig. 5 heated to 60 deg. were built each on a different foundation. Five are set on gravel fills ranging from 2 ft. to 6 ft. deep; one is set on mud sills directly on the surface, and two are set on posts 2½ ft. above the natural surface to allow free air circulation underneath. Several temperature wells are installed under each building. In another place, piles have been driven to various depths from just to the permafrost table to a distance into the permafrost of three times the thickness of the active layer above. The purpose is to check the effect of soil freezing to the piles when the active zone refreezes and to determine the depth piling must be placed in permafrost to prevent its being dislodged by front action in the active layer above permafrost zone.

Fig. 5. Buildings for foundation tests are uniform in all details except floors and foundations.

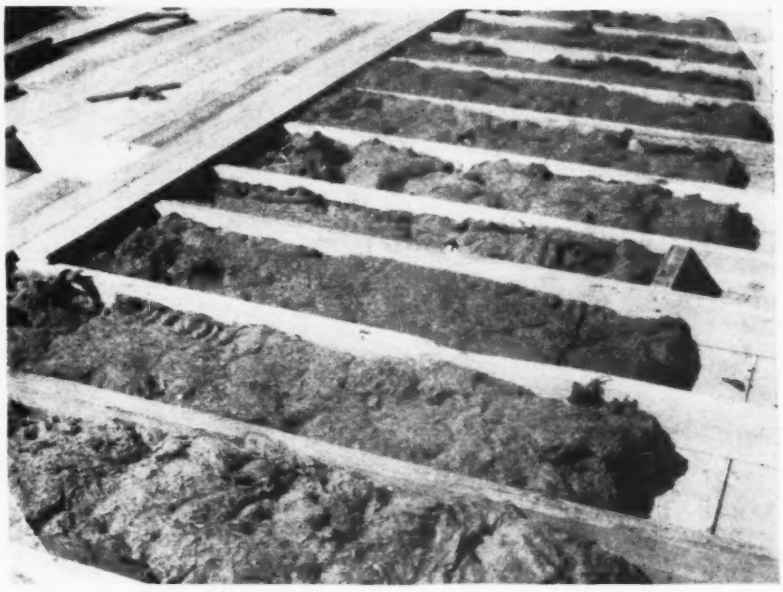


Fig. 6. Rock wool was placed in the floor of one of the test buildings to determine its value in reducing heat radiation.

Throughout the work, details have been varied to determine the effect if any on results. In the building foundations, for example, in one a concrete slab is substituted for the insulated wooden floor shown by Fig. 6, in another a layer of insulating material is inserted in the gravel foundation fill.

All the work heads up in the St. Paul, Minn. District Office, U. S. Engineer Corps. Airplane survey, laboratory and test-field data will be reported to that office to be correlated and reported. It will require several years for conclusions definite enough for design in detail. From the information had it may be concluded in general: (1) Where possible, areas of coarse-grained soils should be selected as construction sites; (2) Where roads and runways are located on fine-grained soil, this should be excavated at least to the permafrost table and backfilled with coarse material; (3) An air space should be provided under heated buildings to decrease heat transfer into the ground, and (4) Piles should be sunk into permafrost to twice the depth of the active zone to prevent frost uplift.

The information for this article was furnished by the U. S. Engineer Office, St. Paul, Minn., for which Col. Walter E. Wilson Jr. is District Engineer and Henry J. Manger is in direct charge of the tests.

Constructing a Big Sewer by Tunneling

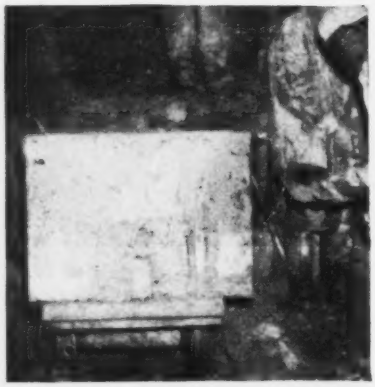


Fig. 1. Excavation is by the top-heading-and-bench method with all material loaded by hand into cars operating on a narrow-gage track.

Fig. 2. An extra box at each shaft is kept on hand to permit a car to return to the heading without delay.

Fig. 3. The boxes are removed from the tunnel with a crawler crane. Material is stockpiled if trucks are not available.

***Contents in Brief**—In building a large sewer by tunneling methods, the contractor used hand tools for the excavation work, in view of the variation in material penetrated and the water encountered. Construction of concrete invert follows closely behind installation of steel arch lining, while erection of the arch is delayed until the brick lining for the invert is in place. Concrete is delivered to steel forms, designed for quick assembly and easy transportation ahead, by a pump located at one of the entrance shafts.*

BECAUSE of its location below a heavily traveled street in a highly developed area, construction of a long large-diameter storm sewer in Washington, D. C., has been restricted to tunneling. Methods producing maximum progress with small crews are being used, and the public has been unaware that the project is going ahead, as no interruption to traffic has occurred. Settlement of the street pavement has been avoided thus far.

Total length of the sewer, which is being built along Fifth Street in the northwest section of the city, is 2,700 ft. For about one-half of the distance a finished inside diameter of 7 ft. is specified and 7 ft. 6 in. for the remainder. Depth of the invert varies from 25 to 40 ft. below street level, placing the sewer below numerous utility lines. The slope of the sewer is two percent.

Minimum thickness of the wall of the sewer is 15 in. For the lower half of the conduit this thickness is made up of 4½ in. of vitrified sewer brick and 10½ in. of concrete, while the crown section is all concrete. Longitudinal reinforcing consists of ½-in. dia. bars on 18-in. centers. The circumferential steel for the invert consists of two layers of ½-in. dia. bars on 7-in. centers, with that for the crown reduced to one layer of the same size and spacing. The overlap of the latter bars with those of the invert is 15 in.

Soft decomposed rock is penetrated for about 600 ft., hard granite for 500 ft., a mixture of decomposed rock and clay for approximately 900 ft., and clayey sand and gravel for most of the remainder. Considerable water is encountered. Two shafts have been put down and two headings are being worked from each shaft with the maximum length of bore to be 900 ft.

Hand methods more economical

Use of a mucking machine for loading materials within the tunnel was considered, but the final decision was to use hand-loading methods. This procedure was selected for the following reasons: (1) no mucker was readily available; (2) great variation in water-saturated material was expected in some sections, and (3) hand tools offered a maximum of flexibility and economy for this particular operation. Excavation is being accomplished by the top-heading-and-bench method.

Special cars operating on lightweight rails of 16-in. gage are used to deliver supplies and to remove excavated material from headings. The all-welded steel box of each car is about 1 cu. yd. in capacity and is not attached to the car's carriage. This design permits loaded boxes to be raised quickly from the shafts by means of a crawler crane operating on the surface (Fig. 3). These boxes are sloped outward at one end to permit quick dumping.

Excavation is speeded by keeping an extra box at the bottom of the shaft on a low platform parallel to the track. As quickly as the loaded box is raised off the carriage an empty box is shifted by hand onto the carriage and the car returned to the heading (Fig. 2). To speed emptying of buckets, excavated material is stock-piled temporarily if no truck is available immediately.

The excavation crew consists of four miners using pneumatic tools, eight muckers, and two car men shifting cars between the heading and the

Fig. 4. The steel lining plate for the arch is supported on 3-in. timber shoring.

shaft. Where the tunnel slopes downward to the shaft, two car pushers can move the loaded cars by hand, but for uphill movement, an air-driven winch is employed. The winch is located in the bottom of the shaft and is powered with air from one of two 315-cfm. portable compressors operating on the surface.

The blasting procedure varies greatly because of the frequent change in the type of material penetrated. Explosives consisting of 40 percent dynamite are discharged in 2½-in. holes 6 ft. deep sunk with pneumatic hand drills. At some locations 18 holes are used, the charge per hole having as many as five ½-lb. sticks, while in other cases only a few holes are drilled and the charge is limited to 1½ lb. per hole. A blast is set off about every 5 ft. along the tunnel.

Steel lining used for arch

Where a 7-ft. dia. sewer is specified, the tunnel is made slightly over 10 ft. in diameter; for the section of 7½ ft. finished diameter an 11-ft. bore is used. The arch of the tunnel is lined immediately behind excavation with 16x36-in. steel liner plate 3/16 in. thick. These plates are equipped with a narrow flange along all four edges that permits the sections to be bolted together. At either side the arch lining is supported on vertical legs of 3-in. thick planking that forms continuous shoring, (Fig. 4.)

To provide maximum safety and to make for easier shifting of muck cars, construction of invert is also advanced as rapidly as possible. Once excavation has advanced 30 ft., a form is installed and concrete placed in this section. The form is made of 6-ft. sections and consists of 3/16-in. steel plate reinforced with four lines of double ribs made of 3x3x¼-in. angles.

Concrete pumped into place

Concrete for both invert and crown is placed by means of a pump. For some sections the pump is located on the surface adjacent to the shaft, and for other sections at the bottom of the shaft. Concrete with a minimum compressive strength of 3,000 psi. at 28 days is specified. The usual mix on a 1-yd. basis is as follows: Sand, 1,206 lb.; aggregate, 1,969 lb.; cement, 5½ bags; and water, 7 gal.

Gravel aggregate is used and the gradation varies from that passing the 1-in. sieve to that retained on the No. 4 sieve. Ordinary Portland cement is specified. Limited to a maximum of 6 in., slump is normally between 4 and 5 in.

Concrete is delivered to the shaft in 4-yd. batches by truck-mounted mixers. It is pumped to the face through 6-in. pipes and is placed at the rate of about 15 cu. yd. per hour with a seven-man crew consisting of two men on the surface and five in the tunnel. The concrete is discharged into the top of the forms first at one side, then the other. As work advances the discharge pipe is shortened in 10-ft. sections without shutting off the delivery pump.

When a heading has been extended for the full distance planned, the brick lining for the invert is added. This lining is used to provide maximum protection against scour, since the sewer will transport storm water containing abrasive particles. Brick is lowered to the shaft bottom and delivered to the desired point in the tunnel by use of boxes and cars previously mentioned. The mortar is mixed on the surface and delivered in ¼-yd. batches, the mix consisting of 94 lb. of cement and 2¼ cu. ft. of sand.

Generally, six men are used for the brick-laying crew. These men include the man preparing the mortar and delivering brick to the bottom of the shaft, one bricklayer, one bricklayer's helper, and two men delivering supplies from the shaft and assisting in shifting the templates and other work. The brick are laid in a 3/16-in. thickness of mortar. For the lower two-thirds of the lining vitrified sewer brick is used, (Fig. 7) for the rest upper third a hard brick not vitrified is specified. The six-man crew lines at least 30 ft. of the sewer, which requires between 2,200 and 2,300 brick, each 8-hr. working day.

Arch built in 60-ft. sections

Construction of the concrete arch is the last operation in lining the

Fig. 5. Reinforcing steel is bent by hand using a wood block template.

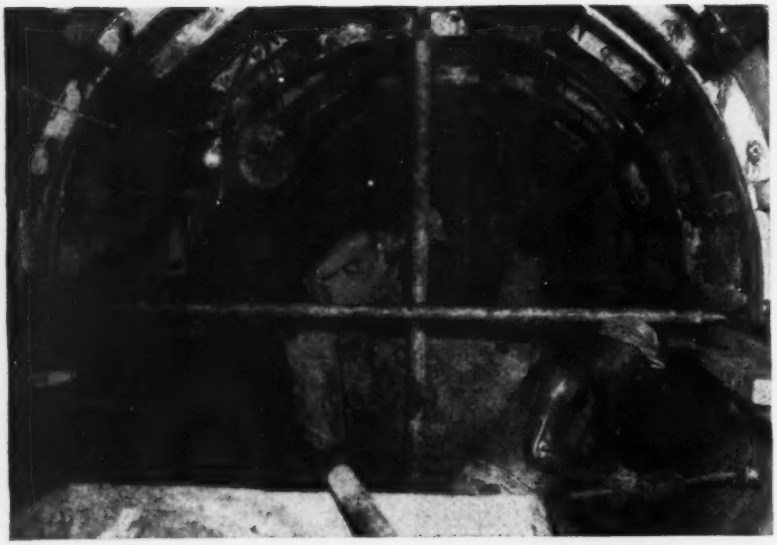


Fig. 6. Arch forms are supported on short sections of 2-in. pipe, set in holes drilled in the invert concrete on 4-ft. centers and by 2½-in. pipe shores spaced at 6 ft. along the center line.

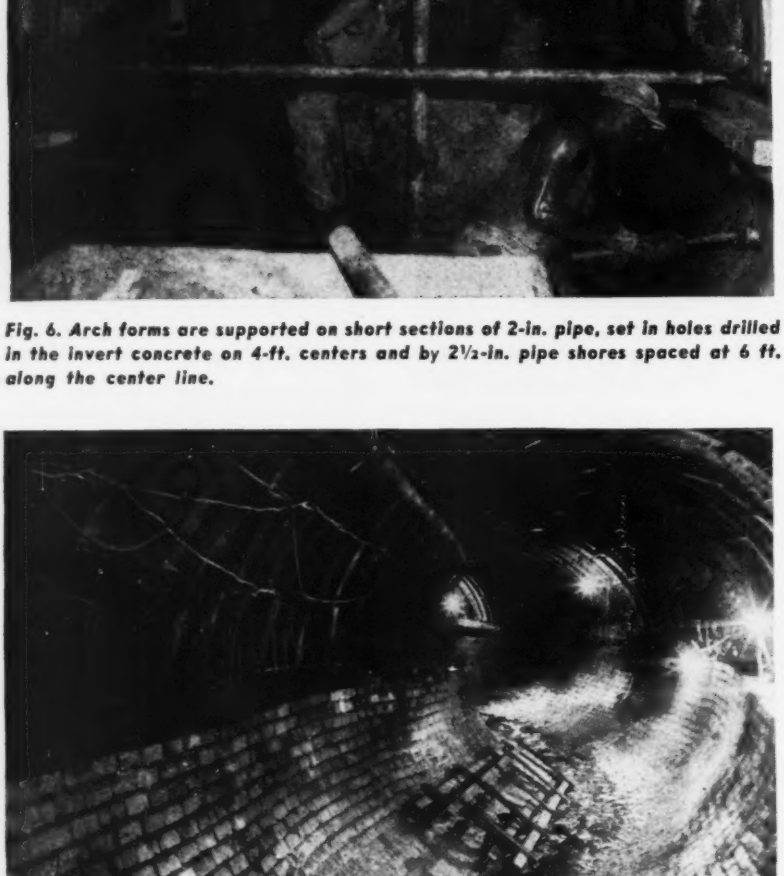


Fig. 7. To provide protection against abrasion, the lower two-thirds of the sewer is lined with vitrified sewer brick laid in mortar over the invert concrete. Above this is hard brick to the mid point of the tunnel. For the upper half, concrete is used inside the liner plates shown in this view.

tunnel. In this work the steel liner plates previously mentioned are left in place. The arch is constructed in 60-ft. sections instead of 30 ft. as with the invert, to permit greater efficiency. The entire 60 ft. of forms is moved ahead on two special carriages operating on a narrow-gage track with each carriage supporting 30 ft. of forms.

The steel forms for the crown are available in 6-ft. sections and they are similar in design to the invert forms. The discharge end of the concrete delivery pipe consists of 50-ft. section with welded joints mounted above the forms at the top of the arch. Placing of the arch concrete starts at the far end of the section being lined. As work progresses, the 50-ft. discharge section is pulled back in 10-ft. jumps by removing a 10-ft. section of the delivery pipe outside of the forms. To shorten the pipe a shut down of less than five minutes is required.

Using the same size crew as in constructing the invert, it is possible to place concrete for 60 ft. of crown in 3½ hr. Normally, this crew constructs 60 ft. of the arch each working day, including the erection of the reinforcing steel, shifting of the forms, and the actual placing of the concrete. There have been no serious delays on the work.

One section requires air

For one section of the tunnel compressed air is being used because of excessive infiltration of water. In this work a 1,000-cfm. diesel-driven compressor was set up on the surface and connected by a 6-in. dia. line to a surge tank 4 ft. in diameter and 8 ft. long, which in turn discharged into the tunnel ahead of the air lock through a 6-in. line. At the onset, a high loss of air occurred; a pressure of only 3 to 4 psi. could be maintained in driving the first 175 ft. from the lock. After this section of the tunnel had been lined, it was possible to mine about 75 ft. additional. However, to advance the work under air, installation of a second 1,000-cfm. compressor was found to be necessary to keep out the water.

With this equipment a pressure of 5 to 6 psi. has been maintained at the heading and it is hoped that the two compressors will be sufficient to complete the bad section, about 500 ft. long.

Good progress is made

Progress to date on the entire project has been good. It is anticipated that the $550,000 job will be completed in nine months. About 40 men are employed on a 48-hr. week. The work is being done by the Square Construction Co., Cleveland, Ohio, with Frank P. Raganese, president, in general charge, and J. Scaravilli in direct charge.

For the District of Columbia Brig. Gen. Gordon R. Young is engineer-commissioner; Harold A. Kemp, director of the sanitary engineering division; Elwood Johnson, deputy director of sanitary engineering, and Y. J. Wright, design engineer in the sewer department.

In the field Y. D. Harbaugh, construction engineer, is in general charge, assisted by R. A. O'Brien.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Folded Scale for Slide Rule

Sir: I was interested in the article, "How To Speed Up Slide-Rule Work" by Dean Lee Johnson (*ENR*, July 24, 1947, vol. p. 112). However, I have seen the same material in his Engineering Problems Manual and in other articles.

I was especially interested to find a name, the "center drift" method, for the procedure I have used since 1927.

Now I don't know whether I should feel proud that I also "discovered", from the manual of instructions, the time-saving method of using folded scales or whether I should kick myself for not telling the world about it long ago. The folded scales constitute a valuable addition to the slide rule. Their use saves time and by the elimination of one or more settings of slide and hairline reduces the liability of error. It is, of course, very important to keep the upper (folded) scales and the C and D scales in proper register—that is, so adjusted that all corresponding indices will coincide at the same time.

As Prof. Ray Ownby of our staff points out, the "efficiency" or saving of time in the use of a slide rule depends very slightly on slide travel. It can be moved the length of the rule in about 0.2 sec. What takes time is the necessary care in setting precisely on the desired point. I would be disposed to ignore that feature of the efficiency question altogether. However, the exercise of judgment in using the proper scales to keep more than half the slide in the frame and thus enable multiplication by a third factor of any magnitude is highly desirable. Since we purchased our first log-log demonstrator ten or more years ago, we have been teaching this principle to our students as an obvious feature of the use of folded scales. That is, of course, what they were designed for.

In his efforts to stay near the center, Dean Johnson in two of his illustrative problems—namely, $\frac{2980}{3.17 \times 4.08 \times 3.43}$ and $\frac{8.16 \times 11.4}{2.85 \times 3.29}$ picks factors, 3.43 and 3.29 out of the order in which they appear in the problems. That is all right for an experienced operator like the dean. In fact, I often do it. However, the student, who starts skipping about to save an inch or so of sliding, is likely to omit or use a factor twice. This has happened on more than one occasion in my experience.

R. T. BROWN,
Assistant Professor of Civil Engineering, The University of Tennessee, Knoxville, Tenn.

Slide Rule Method

Sir: In February, 1927, being a sophomore engineering student, I accumulated $9.85 and purchased a K and E Log-log Duplex Slide Rule. There being no academic course in slide rule available to me, I set about with the aid of the instruction pamphlet accompanying the slide rule to acquire ordinary proficiency in the use of said instrument. During this process I learned to use the "inverted" and "folded" scales and for twenty years have applied "The Center Drift Method" to that type of problem wherein a saving of time resulted. I did this with no realization whatever that I was "pioneering."

"The Center Drift Method" as presented by Dean Johnson (*ENR*, July 24, 1947, vol. p. 112) admittedly has merit and certainly should be used as one method, often quite advantageous, of handling problems in multiplication and division. However, many "old" engineers still use a simple Mannheim slide rule and it is very doubtful if any operator using any improved method could ever "save up to 50 per cent of the time" in the solution of varied engineering problems as compared with men who recognize the slide rule as a tool which will leave time for thinking rather than regarding it as the object of mental effort. For average, everyday problems in engineering work: If "The Center Drift Method" did only require "one-third the amount of movement" and if it did only require "about half as much time", it is doubtful if the time and effort so saved would aggregate many days in the lifetime of the average engineer, who after all—unless he is doing strictly routine sub-professional work—spends far more time thinking than multiplying.

J. C. BRIDGER,
Associate Professor of Civil Engineering, The University of Tennessee, Knoxville.

Wood Pile in Chicago

Sir: In the second paragraph of your editorial on Deep Foundations at Chicago (*ENR*, Dec. 12, 1946, vol. p. 779), a statement is made that "Until about 1880, Chicago was a city of wood pile foundations."

To the best of my knowledge the facts are these: Prior to 1883 there were no pile foundations used, except perhaps under timber elevators along the Chicago river. In 1883 wood piles were used under the river walls of the Sibley (now the Central Cold Storage Co.) warehouse on the north bank of the river immediately east of N. Clark St. In the 1890's wood piles were used in the foundations of the Chicago Public Library building on N. Michigan Ave. between E. Randolph and E. Washington Sts. and the old U. S. Postoffice building (now the Federal building). Few, if any, other buildings used piles. In the Fisher building, short piles were used in an effort to consolidate the upper clay, but no other building, to my knowledge, repeated this experiment.

In 1890 the first Chicago caissons were used under the west wall of the Chicago Stock Exchange building, the remainder of the building being carried on wood piles, but it was not until 1890 that a building on E. Washington St. was built using all caissons.

Except for the above, all Chicago buildings built prior to 1900 were on spread footings, including the 21-story Masonic Temple. In more recent times, caissons were installed under the Fair Store. Recently caissons to hardpan or bedrock have been favored for tall buildings.

FRANK A. RANDALL,
Frank A. Randall and Sons, Structural Engineers, Chicago, Illinois

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

SLAB STRENGTHS COMPARED

To compare the strength of mild-steel reinforcing in a road slab with that of work-hardened steel, the Square-Grip Reinforcement Co., Ltd., of London used the above arrangement. Two 6-in. slabs were cast, each with a different type of reinforcement. Separated by steel pipe spacers, they were stressed simultaneously in bending by tightening the nuts on 1-in. bolts. Springs can be inserted on the bolts against the face of the slabs to measure the force.

Simpler Equation Suggested

Sir: Referring to the problem of finding a simple circular curve of radius R tangent to three lines (*ENR*, June 26, vol. p. 1030) the following equation achieves the same result:

$$(R \tan \tfrac{1}{2} a) + (R \tan \tfrac{1}{2} b) = L$$

$$R = \frac{L}{\tan \tfrac{1}{2} a + \tan \tfrac{1}{2} b}$$

The tangents T_1 and T_2 can then be computed by using $R \tan \frac{1}{2} a$ and $R \tan \frac{1}{2} b$, respectively.

Example:

$a = 45°$, $b = 30°$, $L = 600$ ft.

$$R = \frac{600}{.41421 + .26795} = 879.56 \text{ ft.}$$

$T_1 = 879.56 \times .41421 = 364.32$ ft.

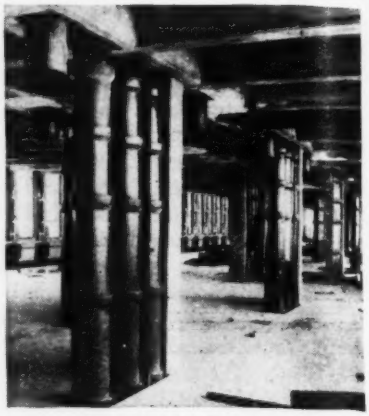
$T_2 = 879.56 \times .26795 = 235.68$ ft.

HOWARD BUNCH
Oklahoma State Highway Department
McAlester, Okla.

Plastic Aids Drafting On Glass-Top Tables

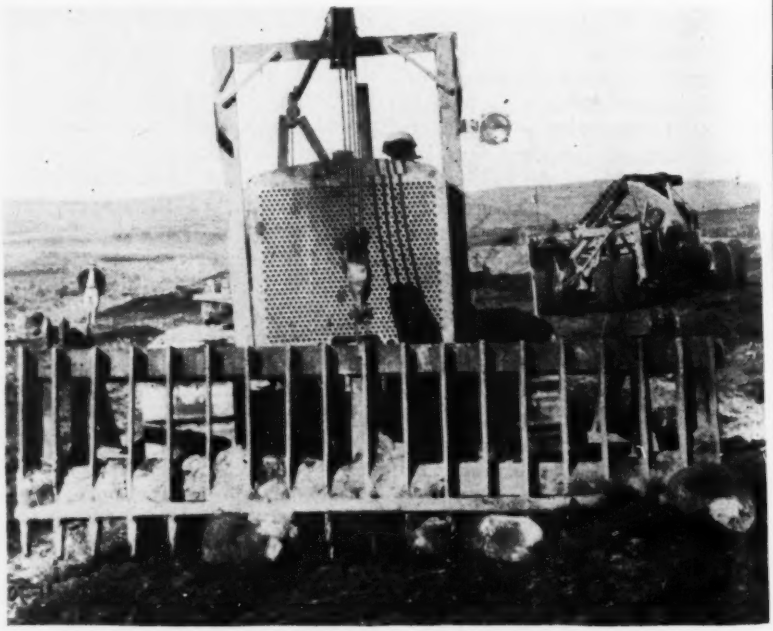
Illuminated glass-top tables are frequently used in drafting rooms to speed tracing. However, the hard surface does not permit penetration of a compass point, and as a result the point or the drawing may be damaged by accidental slipping of the point.

To remedy this, a thin sheet of transparent acetate may be taped down over the glass to provide a soft surface for the compass point. The acetate sheet, which can be purchased in art-material stores, should be sufficiently thick (about 0.015 in.) to lie flat and large enough so that its edges can be taped to the wood frame around the glass—N. Yonteff, *New York 53, N. Y.*



Courtesy of Bell Telephone Laboratories

To preclude disintegration and leakage resulting from hot, acid fumes, vitrified clay pipe ducts were used in the Bell Telephone Laboratories building, Murray Hill, N. J.



SPECIAL RAKE SPEEDS COMPACTING

Substitution of an all-welded rake of the type illustrated for the regular blade of a bulldozer aided in the removal of oversize stone on construction of an embankment for the West Canal of the Columbia Basin project of the Bureau of Reclamation. The Utah Construction Co. and Winston Bros. Co., the general contractors, saved both time and money by use of the special blade. The tractor is pulling two sheepsfoot rollers in tandem.

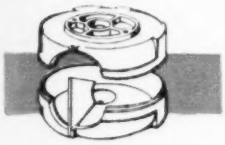
DO THE DISC METERS YOU ARE USING HAVE *All* THESE QUALITY FEATURES?

REGISTERS WITH SWEEP DIAL TEST HANDS

Like the split second hand of a stop watch, the large red center test hand sweeps the entire outer circumference of the dial face. When checking new or repaired meters for accuracy this feature permits much closer reading than when testing against the conventional small circle test hand. The sweep dial test hand can also be used advantageously to detect plumbing leaks since the slightest movement of the hand is readily seen.

ENCLOSED GEAR TRAIN DESIGN THAT RETAINS OIL

A three-wheel type precision cut gear train, completely rubber bushed to hold friction and wear to a minimum, and to insulate the parts from electrolytic action. The gear case is entirely surrounded by water under pressure which aids materially in retaining the gear lubricant within the gear train housing.

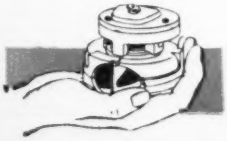


THE CONVENIENCE OF SNAP JOINT MEASURING CHAMBERS

The disc chamber is made in two parts held in proper relation to each other by a mating snap joint without screws. This form of construction is popular with experienced meter men since it simplifies maintenance operations.

THE ECONOMY OF THREE-PART REINFORCED DISCS

The disc complete is made from three individually molded hard rubber parts—a reinforced disc plate and two half balls. This construction assures thorough vulcanization of all units and is economical, too, since in maintenance work any of the individual parts can be replaced.



THE REPAIR EASE RESULTING FROM UNIT ASSEMBLY OF WORKING PARTS

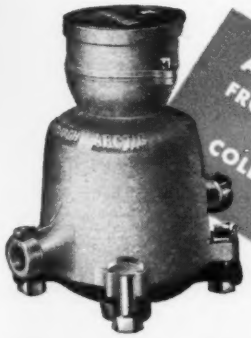
All working parts assemble to form a complete measuring unit *before* being placed in the meter casing. Thus freedom of movement and alignment of the assembly can be checked before the meter is bolted together. A very popular form of construction with meter repair men.

PITTSBURGH EQUITABLE METER DIVISION

ROCKWELL MANUFACTURING COMPANY, PITTSBURGH 8, PA.

ATLANTA BOSTON CHICAGO HOUSTON KANSAS CITY LOS ANGELES NEW YORK PITTSBURGH SAN FRANCISCO SEATTLE TULSA

PITTSBURGH DISC METERS



ARCTIC TYPE
FROST PROTECTED
FOR
COLD CLIMATES

ROCKWELL

TROPIC TYPE
SPLIT CASE
FOR
WARM CLIMATES

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents
October Materials and Labor Prices will appear in the October 16, 1947 issue.
Mexico City, Mexico prices will be published in this section of Engineering News-Record each month.

CEMENT, AGGREGATE, READY-MIXED CONCRETE — F. O. B. CITY

	PORTLAND CEMENT — Per bbl. C/L lots incl. $1.00 per bbl. for bags, cash. dis. not deducted			SAND AND GRAVEL — Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block	CONCRETE Ready Mixed 1:2:4, over
	Cloth	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand grav.	Lt.wgt.Agg.	50 c.y., del.
Atlanta	$3.72	$2.92	$2.67	....	....	....	$2.10	$2.10	$1.65	$1.85	$0.1725	....	$10.05
Baltimore	3.56	2.76	2.51	$2.10‡	$2.10‡	$1.60‡	2.20‡	2.20‡	2.20‡	2.20‡	.145	$0.145*w*	8.55
Birmingham	3.42	2.57	2.32	2.06	2.06	1.63	2.50	2.50	1.00	1.20	.1425	.1425	6.95
Boston	3.98	3.18	2.93	1.50‡*t*	1.50‡*t*	1.40‡*t*	1.25‡*t*	1.35‡*t*	....	....	.186	.195*w*	8.50
Chicago	3.50*mm*	2.70*mm*	2.45*mm*	2.50‡*d*	2.50‡*d*	2.75‡*d*	2.50‡*d*	2.50‡*d*	2.00‡	2.00‡	.195	.195*x*	....
Cincinnati	3.59*v*	2.79*v*	2.54*v*	1.70‡*bb*	1.70‡*bb*	1.60‡*bb*	2.75‡*bb*	2.75‡*bb*	....	....	.17	.195	9.00*hh*
Cleveland	3.60	2.80	2.55	1.90*llg*	1.65*llg*	1.25*ll*	3.20‡*h*	3.20‡*h*	2.45	2.45	....	.20	10.15*aa*
Dallas	3.32	2.47	2.22	1.80	1.80	1.60	1.89	1.99	....	....	.0775*p*	....	8.68
Denver	4.03	3.23	2.98	1.85	2.00	1.15	....	....	....	....	....	.2175*w*	9.25
Detroit	3.40	2.55	2.30	2.75	2.75	2.50	2.50	2.50	2.50‡	2.50‡	.16*w*	.17*w*	8.30*kk*
Kansas City	....	....	....	1.85	1.85	1.40	1.45	1.45	....	....	.16	.16*wy*	9.10*n*
Los Angeles	3.50*eeb*	3.00*b*	2.60*b*	1.55	1.55	1.40	1.40*f*	1.40*f*	1.40*f*	1.40*f*	.125*nn*	.14*nn*	8.75*m*
Minneapolis	3.80	3.00	2.75	2.00*h*‡*j*	2.00*h*‡*j*	1.10*h*‡*j*	2.10*h*‡*j*	2.10*h*‡*j*	....	....	183*cco*	....	9.65*jkk*
Montreal	....	2.17*r*	2.02*r*	1.78*bbs*	1.78*bbs*	1.10*s*	.95*cs*	1.05*cs*	....	....	.1391	.1515*w*	7.75*ls*
New Orleans	3.28	2.48	2.18	1.82	1.82	1.62	....	....	.90	1.18	...	....	9.92
New York	4.70‡	3.70‡	....	1.85*de*	1.85*de*	1.30*de*	1.90*de*	1.90*de*	....	....	18/.20*ii*	.16/.18*wccii*	9.90*k*
Philadelphia	3.42‡	2.62‡	2.37‡	2.20‡	2.30‡	2.05‡	1.90‡	1.95‡	1.50	1.50	.20/.22	.20*w*	9.25
Pittsburgh	3.36	2.56	2.26	1.90‡	1.90‡	2.20‡	2.35‡	2.35‡	1.90	1.90	.22*z*	.22*z*	....
St. Louis	3.72*o*	2.87*o*	2.62*o*	2.25‡*oh*	2.25‡*oh*	2.00/2.25‡*oh*	1.35*c*	1.35*c*	....	....	.195	.22*yo*	10.15
San Francisco	3.74*jj*	2.84	2.44	1.71	1.71	1.81	1.81	....	....	....	....	.25*y*	9.80*u*
Seattle	3.35*gg*	3.10	2.80	2.50‡*od*	2.50‡*od*	2.50‡*od*	3.00‡*od*	3.00‡*od*	....	....	.18*o*	....	8.75*o*

‡ Delivered. *b* 20c. per bbl. off for payment by 10th of following month. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* Pea gravel. *h* Truck Lots. *i* ¼ in. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% 0ñ for cash. *p* 5½ x 8 x 12 in. *r* 10¢ per bbl. off cash 20 days. *s* 8% sales tax included. *t* Truck delivery. *u* 10 to 100 c.y. brackets. *v* Includes dealer's commission. *w* Cinder. *x* Waylite. *y* Havdite. *z* Celocrete. *aa* Aver. haul, 7–9 mi. zone. *bb* 5 tons or more. *cc* Also 8 x 8 x 18 in. *ee* 20c refund for each returnable bag. *gg* 10c. refund for each returnable bag. *hh* Truck loads up to 500 c.y. Over 500 c. y. lots, 50¢ less per yd. *ii* Yard price. *kk* 2500 lb. compression strength. *jj* 30¢ refund for each returnable bag. *ll* Price at plant. Called for. *mm* Add 1¢ to 15¢ for dealer markup. *nn* 4 x 8 x 12 in.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add $1.05 per bbl.; 25c. refund allowed for each returnable bag; for paper bags add 25c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$2.10	$2.10	Ironton, Ohio	$2.05*	$2.05*	Universal, Pa.	$2.10	$2.10
Hannibal, Mo.	2.10	2.10	Northampton, Pa.	2.00	2.00	Waco, Tex. (Plus 9c. tax in Tex.)	1.95	1.95
Independence, Kans.	2.10	2.10	Richard City, Tenn.	2.10	2.10	Montreal City (Discount 10c. per bbl. 20 days)	1.88	1.88
			Steelton, Minn.	2.20	2.20			

* Destination price base effective Aug. 14, 1947

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS — F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT Per ton, less than 80 penetration		ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration		CUTBACK ASPHALT Per ton		ROAD OIL Per gal.	ASPHALT EMULSION (Quick-breaking) Per gal.	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	$14.00	.....	$0.074	.....	$0.0806*h*	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70‡	85.00*m*	15.00	$21.00	.06	$0.09	13.00	$23.00	.06	.07	$0.14
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	85.00	59.00	3.75	17.00*o*	29.50*o*	.0723*o*	.1447*o*	.075*ho*	.15*ho*	.07*o*	.0907*o*	.18*o*
Chicago	150.00‡*y*	68.00/70.00*s*‡	2.97/4.10*d*‡	18.00/19.00*b*	26.00/26.50*b*	17.00*bg*	24.50/25.00*bg*	.085/.0875*bh*	.17/.1725*bh*	.0675/.07*b*	.0925/.1025*b*	.14/.165*b*
Cincinnati	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	150.00	47.00*t*	3.43	24.50	36.00	24.50*g*	36.00*g*	.105*h*	.24*h*	.11	.135	.24
Dallas	*l*	40.00	*l*	16.95	29.15	.0686	.1225	20.00	37.60	.05	.0675	.....
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	63.00*x*	.....	20 00	26.00	18.40*g*	24.40*g*	.0811*h*	.128*h*	.075	.1085	.1522
Kansas City	.....	40.00	.....	17.60	.....	16.00*g*	.....	.08*h*	.....	.0575	.09	.....
Los Angeles	*l*	60.00	*l*	9.50*b*	24.00*b*	10.00*bg*	24.50*bg*	10.00*b*	.....	.04*b*	.10*b*	.20*b*
Minneapolis	.....	.....	2.39*d*	23.00	32.00	17.00*g*	28.00*g*	23 00	33 00	.08	.09	.15
Montreal	.....	.....	.....	16.60*k*	24.25*k*	11.60*kp*	14.80*kp*	11.50*kp*	13.50*kp*	.08*kj*	.135*k*	.188*k*
New Orleans	.....	.....	.....	15.50*a*	.....*s*	13.50*ga*	.....*s*	6.75*a*	.....*s*	.055	.08	.13*n*
New York	.....	.....	2.50*d*	20.68	32.85*s*	19.68*g*	38.68*g*	.0857*h*	.1669*h*	.0807	.0855	.1643
Philadelphia	150.00	62.00	4.06	19.00	.....	17.00*g*	.....	.08*h*	.....	.....	.....	.....
Pittsburgh	142.00	42.00	3.90	20.00	30.00	10	.20	22.00	34.00	.08	.09	.18
St. Louis	.....	42.00	.....	17 00	23.00	16 00*g*	22.00*g*	075/.08*h*	.165/.17*h*	.065/.07	.095/.105	.145/.1675
San Francisco	.....	54.00*c*	.....	13.00	26.50*w*	13 00*g*	.....	13.50	.....	.....	.0575	.1275
Seattle	.....	.....	.....	13.00*i*	27.00*i*	11.00*ig*	.....	13.50*i*	17.50*i*	12.50*ig*	.0575*i*	.0725*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 2½ x 8½ x 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½. *g* Per ton. *h* Per gallon. *i* F.o.b. Martines. *j* Shipped in drums. *k* Tax included. *l* Not used. *m* Per thousand. *n* 55 gal. drums. *o* Price at plant. *p* Per 100 gal. *s* Drums not available. *t* Truck deliveries in Greater Cleveland *w* Shipped in double head wood barrels. *x* Truck deliveries in Detroit $75.00. *y* Carload lots.

IRON AND STEEL PRODUCTS — BASE MILL PRICES

	STRUCT. SHAPES–PLATE/	REINF. BARS billet *be*/	RIVETS ½-in. structural/	WIRE NAILS Base *df*/	SHEET PILING Base/	STEEL RAILS Per Net Ton Standard	STEEL RAILS Per Net Ton Light	STEEL RAILS Per Net Ton Re-rolled	TRACK SUPPLIES/ Angle Bars	TRACK SUPPLIES/ Std Spikes *c*	TRACK SUPPLIES/ Tie Plates *c*	TRACK SUPPLIES/ Track Bolts
Birmingham	$2.80	$2.75	$5.25	$4.25	...	$55.00	$62.00	Not	$3.25	$4.00/4.50	$3.05	$7.00
Chicago	2.80	2.75	5.25	4.25	$3.30	.....	.....	avail-	3.25	4.00/4.50	3.05	7.00
Pittsburgh	2.80	2.75	5.25	4.25	3.30	55.00	62.00	able	3.25	4.00/4.50	3.05	7.00
Buffalo	2.80	2.75	....	....	3.30	.....	.....	....	....	....	3.05	....
Cleveland	....	2.75	5.25	4.25	....	.....	.....	....	....	.....	.....	....
Youngstown	....	2.75	....	....	....	.....	.....	....	....	4.00/4.50	.....	....
Detroit	....	....	....	....	....	.....	.....	....	....	....	....	....
Gulf ports	....	....	....	....	....	.....	.....	....	....	....	....	....
Geneva	2.975‡	....	....	....	....	.....	.....	....	....	....	....	....
Los Angeles	3.17/3.41‡	3.325‡	....	....	....	.....	.....	....	....	....	....	....

‡ Delivered. *b* Rail steel same as billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone. Steelton, Pa., on spikes alone. Lebanon, Pa., Richmond, Va. lengths. Add 50¢ for cut lengths. *d* Add switching charge $18 per cl. *e* Mill *f* Per 100 lbs.

IRON AND STEEL PRODUCTS — F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS*g* Per 100 lb., base price *u* 5 tons to carload lot *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH*k* Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per 100 s. f.	SHEET PILING Per 100 lb base price
Atlanta	$5.02‡	$5.12‡	$5.12‡	$.025	$.10	$31.00	$33.00	$2.07	$1.55	$2.18	....
Baltimore	4.25	3.635*l*	....	....	.10	29.00	31.00	1.95	1.47	2.06	$4.25
Birmingham	4.05	3.50	3.50	.05	.10	37.50*p*	40.50*p*	2.05	1.54	2.16	....
Boston	4.92‡	4.65‡	....	....	.10/.15	26.00	28.00	2.01	1.51	2.11	3.443*k*
Chicago	4.40	.....	....	.05	.05	24.00‡	26.00‡	1.92	1.45	2.02	3.30*a*
Cincinnati	4.744‡	3.819*c*	3.819*c*	....	....	35.00‡*s*	36.00‡*s*	1.94	1.46	2.02	3.64*d*
Cleveland	4.611	3.90†	....	....	.10	29.00	31.00	1.94	1.45	2.01	....
Dallas	6.72	5.50	5.50	....	....	29.15	31.35	2.18	1.62	2.28	....
Denver	5.50	4.97*e*	....	....	....	36.00	41.00*q*	2.22	1.65	2.34	....
Detroit	4.72‡	4.141	4.141	....	.10	30.00*x*	32.00*q*	1.93	1.46	2.03	3.6193*yd*
Kansas City	5.15	4.25*aad*	4.25*aad*	.0	.05	34.00	36.00	2.03	1.53	2.14	3.0826*a*
Los Angeles	5.20*f*	3.025	2.875	.03	.05	23.00	27.50	2.18	1.62	2.30	5.50*d*
Minneapolis	4.734‡	4.774*eon*	4.77*eon*	.0	.10	29.50*h*	31.50*h*	2.05	1.54	2.16	3.77*k*
Montreal	4.55*i*	4.20*i*	4.20*i*	....	....	36.00*h*	38.70*h*	2.87	3.54*i*	2.96*im*	73.00*yd*
New Orleans	....	4.63*ok*	....	.05	.10	27.50	29.50	2.07	1.55	2.18	.....
New York	4.52*r*	4.40	....	....	.15/.20	33.502*st*	35.505*st*	2.20	1.55	2.25	3.35*a*
Philadelphia	3.97	4.59	....	....	....	27.00‡	29.50‡	1.96	1.48	2.06	3.41
Pittsburgh	4.40	4.10	4.10	.05	.10	26.00	29.80	1.84	1.40	1.94	5.05
St. Louis	4.699‡	3.84*cbb*	3.84*cbb*	.0	.05	34.00‡	36.00‡	1.94	1.47	2.03	....
San Francisco	5.20	4.53	....	....	....	32.50	34.50	2.18	1.62	2.30	4.85
Seattle	3.628*e*	4.43*e*	....	....	....	43.00*w*	46.00*w*	2.18	1.62	2.30	4.355*dd*

‡ Delivered. *a* Mill prices. *b* 1-5 tons, add 35c. Less than 1 ton, add 50c. *c* 20 tons or over base. *d* Mill price plus freight. *e* F.o.b. plant *f* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15c. differences between new billet and rail steel. *h* List price. Dominion tax exempt. Provincial and Municipal tax extra. *i* Plus Dominion, Provincial and Municipal sales tax. *j* Price per ton. *k* F.o.b. city. *l* Intermediate. *m* Per sq. yd. *n* 5 to 8 tons base. *o* 5 to 15 tons base. *p* Del. of 5000 sq. yd. or less. *q* Std. ribbed. 4 lb. per sq. yd. *r* 5 tons or over. *s* LCL. *t* Asphalt coated. *u* Note: Revised size extra—1 in., 1¼ in., 1½ in. 10¢, ¾ in., ⅞ in. 15¢, 1 in. 20¢, 1¼ in. 35¢, 1½ in. 55¢, 2 in. $1.30. *v* Under 20 tons. Straight. *w* Copper bearing. *x* 2.5 lb. per sq. yd. *y* $.0093 transportation tax included. *z* Copper alloy. *aa* 20 tons base. *bb* F.o.b. warehouse prices unchanged at $3.84 since May. *cc* F.o.b. cars Chic. plus freight. *dd* F.o.b. dock. † Price includes quantity and size charge but no switching charge. Comparable Aug. price was $3.70.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, Delivered ASTM C13–44T std. 8 in. s.s.	std. 12 in. s.s.	24 in.	36 in	CLAY DRAIN TILE ASTM C4–24 Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTMC 14–41 12 in.	24 in.	WROUGHT STEEL PIPE (Full standard weight, f.o.b. destination *s*) 2½ & 3 in., Butt Weld** Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$79.78	$0.43	$0.67	$3.39	$7.00	$114.00	$140.00	$0.45	$2.00	50.7	36.2	46.7	31.7
Baltimore	84.10	.35	.60	2.70	7.25	160.00	200.00	.70	2.05	54.4	39.9	50.4	35.4
Birmingham	74.50	.375	.675	3.06	....	210.00‡	375.00‡	.75	....	50.7	36.2	46.7	31.7
Boston	86.70	.392*uvx*	.756*uvx*	3.465*uvy*	8.7125*uvy*	150.60	233.40	.53*h*	2.04*h*	52.7	38.2	48.7	33.7
Chicago	85.06	54	1.04	4.12	12.80	150.00‡	270.00‡	.65	2.25	56.5*t*	42.0*t*	51.5*t*	36.5*t*
Cincinnati	83.86	.406	.783	4.00	12.00	155.00‡	240.00‡	.54	1.98	54.9	40.4	50.9	35.9
Cleveland	85.54	.329*x*	.6345*x*	2.79*x*	7.38*x*	127.00	199.00	.58	2.25	57.15	42.65	53.15	38.15
Dallas	87.28	.375	.675	2.70	6.20	109.00	131.00	.45	1.45	48.8	34.3	44.8	29.8
Denver	92.12	.38	.68	2.84	....	.....	.....	.64	2.25	46.9	32.4	42.7	27.7
Detroit	85.54	.455	.8775	3.69	8.50	170.00‡*m*	260.00‡*m*	.50	1.90	55.4	40.9	51.4	36.4
Kansas City	86.62	.345	.625	2.48	6.85	175.00	310.00*m*	.50	1.70	52.2	37.7	47.8	32.8
Los Angeles	98.50	.414†	.745†	2.988	7.47	157.00	260.00	1.25	2.50	....	....	....	....
Minneapolis	88.60	.51*mo*	.98*mo*	3.95*mo*	....	.....	.....	1.05*h*	2.90*h*	52.3	37.8	47.9	32.9
Montreal	78.20	.68*s*	1.20*s*	3.94*s*	6.38*es*	.48*paa*	.68*paa*	72.00*jkaa*	218.00*jkhaa*	....	....	....	....
New Orleans	82.18	.40	.72	3.06	....	220.00*bb*	.....	.55	1.95	50.3	35.8	46.3	31.3
New York	83.30	.59	1.09	4.24	10.79	.....	.....	1.00	2.25	53.7	39.2	49.7	34.7
Philadelphia	81.70	.50	.95	3.95	9.75	220.00‡	275.00‡	1.05*h*	2.75*h*	54.2	39.7	50.2	35.2
Pittsburgh	86.02	.357*m*	.6585*m*	2.70*m*	6.625*m*	126.20	197.40	1.05*h*	2.50*y*	57.5*t*	42.0*t*	53.5*t*	38.5*t*
St. Louis	83.38	.40	.72	2.88*	6.53*	.....	.....	1.10*il*	2.15*il*	54.1	39.6	49.2	34.2
San Francisco	98.50	.4375*d*	.7875*d*	3.15*d*	7.875*d*	159.00*dl*	265.00*dl*	.69	2.85	....	....	....	....
Seattle	100.30	.45*b*	.81*b*	....	....	72.50*c*	.....	.595	1.80	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, CL, Burlington, N. J. (base) $79.50. Based on existing freight rates; subject to rate change. Gas pipe and class A, $5 per ton additional. 4 in., $5 per ton additional. 30 in. and larger, usually $1 per ton less. *b* Extra strength ASTM C 200–44T. *c* 4-in. *d* SS361-A. *e* 30 in. *g* Culvert pipe. Reinforced, ASTM C76–41. *h* Reinforced. ASTM C75–41. *i* Reinforced. ASTM C76–37. *j* Centrispun. *k* Per 100 ft. *l* F.o.b. plant. *m* Truck delivery. *o* Listed price is based on LCL (no minimum). *p* Less than 5 ton loads, price per ft. *s* Discounts from standard list consumers carload prices. Base price approx. $200 per net ton. List prices per ft.: ¼ in., 8¼c.; ⅜ in., 11¼c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76¼c.; 4 in., $1.09; 6 in., $1.92; 3 percent tax on transportation costs not included. *t* Within switching limits. *u* ASTM C13–40. *v* F.o.b. city. *x* 2 ft. lengths. *y* 3 ft. lengths. *z* CESA A60–1941 specifications used. *aa* No standard specifications in Can. *bb* Freight allowed to destinations in city. * Correction: Prices for ASTM C13–44T all along. ** **Discounts now quoted separately on different sizes. Discounts on "2½ & 3 in." to replace previous series.**

WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt weld — 1 in. and 1¼ in. black, 34 galv., 16; 1½ in. black, 38 galv., 18½; 2 in. black, 37½, galv., 18. Lap weld — 2½ in. to 3½ in. black, 31½, galv., 14½; 4½ in. to 8 in. black, 32½, galv., 17. Freight rates to destination to be added to name delivered price.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F. O. B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR									LONG LEAF Y. P.		PLYWOOD	
	All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)									Merchantable grade		Rail freight increment	
	All Fir planks No. 2 common. Fir timber is No. 1 common.					*Lengths up to 20 ft.*		*(Prices in italics)*		up to 20 ft.		(See note for base price)	
	1x6 s4s	1x8 s4s	2x4 s4s	2x6 s4s	2x8 s4s	2x10 s4s	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	⅜"	¼"
Atlanta	**$72.00**	**$72.00**	**$62.00**	**$62.00**	**$62.00**	**$62.00**	**$82.00**	.....	.....	.....	.....	**$18.60**	**$22.70**
	85.00	*85.00*	*95.00*	*95.00*	*95.00*	*95.00*	*85.50*	*$85.50*	*$85.00*	.....	.....	.....	.....
Baltimore	**78.00**	**80.00**	**80.00**	**78.00**	**82.00**	**86.00**	**95.00**	.....	.....	160.00	150.00	19.05	23.25
	88.00	*90.00*	*93.00*	*92.00*	*94.00*	*94.00*	*100.00*	*100.00*	*100.00*	.....	.....	.....	.....
Birmingham	**87.50**	**87.50**	**87.00**	**86.00**	**87.00**	**90.00**	**110.00**	.....	.....	110.00	112.50	18.15	22.15
	92.50	*92.50*	*92.00*	*91.00*	*92.00*	*95.00*	*114.00*	*97.00*	*98.00*	.....	.....	.....	.....
Boston	70.00[3]	72.00[3]	66.50[3]	68.50[3]	70.50[3]	74.50[3]	70.25[3]	.....	.....	.....	.....	19.05	23.25
	64.75[i]	*64.75[i]*	*62.75[i]*	*63.25[i]*	*62.75[i]*	*62.75[i]*	*60.50[i]*	*59.50[i]*	*59.50[i]*	*59.50[i]*	*59.50[i]*	.....	.....
Chicago ‡	**88.00**	**90.00**	**78.00**	**75.00**	**75.00**	**85.00**	**85.00**	.....	.....	115.00	115.00	15.60	19.00
‡	*93.00*	*93.00*	*83.00*	*80.00*	*80.00*	*90.00*	*90.00*	*90.00*	*90.00*	.....	.....	.....	.....
Cincinnati	**70.00**	**72.50**	**75.00**	**77.00**	**78.00**	**80.00**	**104.00**	.....	.....	95.00	120.00	18.15	22.15
Cleveland k	**105.00**	**105.00**	**105.00**	**105.00**	**105.00**	**110.00**	.....	.....	.....	.....	.....	18.50	22.60
k	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	.....	*130.00*	*130.00*	.....	.....	.....	.....
Dallas	**59.00**	**59.00**	**56.75**	**57.75**	**59.00**	**61.50**	**61.00**	.....	.....	94.75	91.00	15.60	19.00
Denver	*93.50*	*93.50*	*97.00*	*97.00*	*96.50*	*96.50*	.....	.....	.....	.....	.....	11.60	14.15
Detroit	**85.00**	**85.00**	**86.00**	**85.00**	**86.00**	**88.00**	**86.00**	.....	.....	88.00	105.00	18.15	22.15
	98.00	*98.00*	*92.00*	*92.00*	*98.00*	*95.00*	*100.00*	*100.00*	*105.00*	.....	.....	.....	.....
Kansas City a	**85.00**	**85.00**	**85.00**	**85.00**	**75.00**	**80.40**	**95.00**	.....	.....	105.00	110.00	13.80	16.80
	90.00	*90.00*	*90.00*	*90.00*	*77.00*	*82.00*	*96.50*	*105.00*	*110.50*	.....	.....	.....	.....
Los Angeles a	*78.30*	*78.30*	*79.20*	*80.00*	*78.30*	*78.30*	*91.00*	*91.00*	*80.00*	.....	.....	11.15[g,h]	13.55[g,h]
Minneapolis b	102.00[3]	102.00[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.80	16.80
b	*98.00*	*98.00*	*98.00*	*98.00*	*98.00*	*100.00*	*125.00*	*125.00*	*125.00*	.....	.....	.....	.....
Montreal e	69.00	70.00	64.00	68.00	70.00	75.00	.....	.....	.....	.....	.....	.....	.....
	97.00	*97.00*	*97.00*	*97.00*	*97.00*	*97.00*	*87.00*	*87.00*	*87.00*	.....	.....	.....	.....
New Orleans	**60.00**	**60.00**	**60.00**	**60.00**	**60.00**	**65.00**	**105.00**	.....	.....	100.00	105.00	15.60	19.00
	61.00	*61.00*	*58.50*	*56.50*	*58.50*	*54.50*	*60.00*	*60.00*	*90.00*	.....	.....	.....	.....
New York ‡	**97.50/105**	**97.50/105**	**Range from $95.00 to $99.00**				**120.00**	.....	.....	.....	.....	19.05	23.25
‡	.....	.....	*Range from $100.00 to $110.00*				*100/115*	*110/115*	*110/115*	.....	.....	.....	.....
Philadelphia	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	.....	.....	150.00	150.00	19.05	23.25
	120.00	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	.....	.....	.....	.....
Pittsburgh	**59.40**	**61.80**	**71.35**	**63.60**	**69.45**	**73.10**	**84.85**	.....	.....	130.60	141.00	18.80	22.90
	77.60	*76.70*	*74.70*	*73.90*	*73.80*	*74.35*	*91.35*	*96.85*	*96.85*	.....	.....	.....	.....
St. Louis ‡j	**95.00**	**95.00**	**98.00**	**95.00**	**95.00**	**98.00**	**105.00**	*130.00*	*130.00*	105.00	105.00	15.60	19.00
‡j	*110.00*	*110.00*	*115.00*	*115.00*	*115.00*	*115.00*	*120.00*	.....	.....	.....	.....	.....	.....
San Francisco d	*74.50*	*74.50*	*74.50*	*74.50*	*72.50*	*74.50*	*74.00*	*74.00*	*74.00*	.....	.....	8.40[g]	10.25[g]
Seattle	*70.00[i]*	*70.00[i]*	*70.00[i]*	*70.00[i]*	*70.00[i]*	*70.00[i]*	*75.00[i]*	*75.00[i]*	*75.00[i]*	.....	.....	.....	.....

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [3] Spruce. [4] Western Pine, No. 3 Common. [5] Norway Pine. ‡Delivered. *a* Yard prices. *b* Retail prices, less than CL. *c* 5 M ft. or less. *d* Sales through wholesale distribution yard (F.o.b. purchaser's truck or carrier. San Francisco paid). *e* Tax exempt. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* No. 1 common. *j* Delivered in 5000 ft. lots. *k* These are retail yard prices quoted per truckload in Greater Cleveland. Less 2% for cash. Truck lots.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ¼", $149.00; on ½", $169.00. For other centers add rail freight increment from table on proper size. For oiling add $3.00; for edge sealing add $2.00; for resin sealing add $8.50.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Jan. 16, 1946 — Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*	
	A quality	B quality		
Atlanta	76%	76%	**$0.195**	
Baltimore	70–10%	71–10%	.195	
Birmingham	68%	68%	.15	
Boston	77%	78%	.195	
Chicago	68%*e*	68%*e*	.195	
Cincinnati	67&10%*g*	67&10%*g*	.195	
Cleveland	67–10–10%	67–10–10–10%	.195	
Dallas	67%*e*	68%*e*	.2075	
Denver	68%	68%	.20	
Detroit	77%	76%	.195	
Kansas City	68.10%*g*	68.10%*g*	.195	
Los Angeles	86%*d*	88%*d*	.2025	
Minneapolis	68%	68%	.19	
Montreal	40–5%*ab*	40–10–5%*ab*	.2125	
New Orleans	68%	68%	.205	
New York	73%	74%	.265*f*	
Philadelphia	69%	70%	.195	
Pittsburgh	77–10%	77–10%	.1675	
St. Louis	70–10%	70–10%	.20	
San Francisco	66%	73%	.20	
Seattle	59%	60%	.2025	

Price of 60% Ammonia Gelatin is $0.0125 per lb. higher than 40%

a Discount from list, Sept., 1939; sales tax included, but 6% tax exemption not allowable for. *b* Single thickness. *d* Discount from jobbers list Sept. 15, 1928. *e* Discount from list of Jan. 29, 1947. *f* In borough of Kings, Queens and Richmond, and in Manhattan south of Canal St., add delivery charge of $6.00 per trip. *g* Discount from list of Aug. 15, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.15	$0.175	$0.195
W. of Miss. to Rocky Mtn. States, Fla. and Maine	.155 –.1625	.18 –.1925	.20 –.2125
Rocky Mtn. States	.155 –.1675	.18 –.1975	.20 –.2175
Pacific N. W. States	.1525–.165	.1825–.195	.2025–.215
Pacific S. W. States	.15 –.1575	.18 –.1875	.20 –.205

PILES, TIES F. O. B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail — Pine*	By Rail — Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	....
12-in.— 2-ft. from butt	6-in.	50 to 59-ft.	.35	....
12-in.— 2-ft. from butt	6-in.	60 to 69-ft.	.36	....
12-in.— 2-ft. from butt	6-in.	90 to 100-ft.	....	.55
13-in.— 3-ft. from butt	5-in.	91 to 100-ft.	....	.59
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.41	.66
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.43	.60
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.54	....
14-in.— 2-ft. from butt	5-in.	85 to 89-ft.	.57	....
14-in.— 2-ft. from butt	5-in.	90 to 100-ft.	....	.66

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.45	.....	$2.00	.....
	Pine	1.35	$3.05*a*	1.90	$4.00*a*
New York	S. L. Sap Pine	1.65	2.85	2.00	3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.65/2.75*a*	....	3.55/3.70*a*
Los Angeles	Douglas Fir	2.10	3.35*a*	3.00	4.80*a*
Philadelphia	Red Oak	2.25	3.05*ag*	3.00	4.15*ag*
St. Louis	White Oak	1.80	....	2.50	....
	Red Oak	....	2.40*a*	....	3.40*a*
	Sap Pine or Cypress	2.20	....	....	....
San Francisco	Douglas Fir	1.28*ef*	2.56*f*	1.68*bf*	3.36*caf*
Montreal	Birch or Maple	....*h*	....*h*	....*h*	....*h*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 7" x 9" x 8'. *c* Empty cell. *e* Green. *f* F.o.b. cars. *g* January, 1943 price, none later available. *h* No constant price available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100 lb.	$2.75– 3.00
Chlorine cylinders, liquid, per lb. delivered	.0675
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, del'd, ton	24.00–40.50
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.55
Soda ash, 58%, in paper bags, per 100 lb. dense	1.28
Sulphate of aluminum, commercial, in 100-lb. bags	1.15–1.30
Sulphate of copper, in bbl., per 100 lb.	7.60

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME — DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over, 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity Common backing	Straight hard	LIME Per ton, In paper, Hydrated finishing	Carload lot, Common hydrated	Pulverized, or lump
Atlanta	.....	.....	.....	.....	.....	.....	$24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	$110.00	$116.00	$208.00	$225.00	$290.00	$320.00	24.00*k*	30.00*k*	22.50	17.50	2.75*m*
Birmingham	97.50	104.00	195.00*e*	231.00	.....	.....	19.50*ff*	21.50*gg*	21.80	17.50	.....
Boston	105.00†	112.00†	210.00†	252.09†	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	115.00	122.50	230.00	.....	.....	.....	18.50	19.50	24.00	18.00	.....
Cincinnati	150.00*j*	160.00*j*	210.00*jdd*	290.00*j*	.....	.....	27.50	27.50	25.60	23.20	.....
Cleveland	99.50*cc*	106.00*cc*	195.50*cc*	.....	.....	.....	24.00	24.00	19.65	17.15	22.15*ee*
Dallas	.....	83.00	.....	.....	.....	.....	18.00	20.00	28.00	22.00	.....
Denver	105.25	119.00	198.25	230.00	263.50	315.35	27.50	.....	34.80*bb*	28.00*bb*	34.00*bb*
Detroit	126.00	134.00	252.00	285.00	370.00	423.00	26.00*f*	28.00*f*	26.00	24.00	24.00
Kansas City	.....	.....	.....	.....	.....	.....	.....	.....	34.00	30.00	30.00
Los Angeles	*r*	*r*	*r*	*r*	*r*	*r*	18.00	20.50	21.80	18.80	22.80
Minneapolis	144.00*p*	159.50*p*	.....	159.50*wp*	.....	.....	22.00*xp*	.....	30.00*bbe*	23.00*bbe*	30.00*bbde*
Montreal	92.50*a*	98.50*a*	196.25*a*	151.50*ag*	.....	294.40*a*	22.16	31.86	12.50*ub*	14.00*u*	8.00*uo*
New Orleans	160.00	160.00	300.00	380.00	411.89	485.91	22.50	.....	21.20	18.00	14.10
New York	103.90	110.80	152.35*c*	166.70*hn*	.....	.....	28.00	.....	33.50	25.50	.....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	24.75	27.75	26.75	17.00	17.00
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	26.00	28.00*y*	19.40	16.90	2.85*m*
St. Louis	101.15	112.95	209.60	220.50	273.60	304.00	28.00*al*	25.00*s*	.65*aaap*	.50*aaap*	.75*aaspae*
San Francisco	124.00	139.50	186.00*dd*	139.50*t*	.....	.....	27.50	.....	23.10	23.10	2.31*m*
Seattle	137.00*cc*	147.00*cc*	.....	147.00*ccw*	.....	.....	28.50	33.50	27.95*s*	27.95*s*	3.28*m*

† F.o.b. *a* Smooth. *b* Per 50 lb. bags. *c* 6 x 12 x 12 in.-3 cell. *d* Pulverized hot. *e* 5% discount for cash. *f* Includes $3.50 per M for truck delivery. *g* 5½ x 8 x 12. *h* F.o.b. Perth Amboy, N. J. *i* F.o.b. warehouse only. *j* Truck load or over. *k* $1.00 discount. *l* Red face. *m* Per bbl., 180 lb. *n* 7¾ x-7¾ x 12. Speed tile. *o* Per bbl., 200 lb. *p* Truck lots. *r* Not used because of earthquake danger. *s* 2% discount for cash. *t* 5½ x 8 x 11¼. *u* Tax exempt. *v* Sand lime. *w* 5 x 8 x 12. *y* Stacked. *z* Pebble lime price per 80 lb. sack. *aa* Price per sack. Lime not sold per ton. *bb* LCL. *cc* Truck delivery. *dd* 6 x 12 x 12. *ee* Pebble lime. *ff* 80% common. *gg* Select.

PAINT, ROOFING — F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in 100 lb. cases In oil *w*	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85-90 lb per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$18.75	$27.375	$1.75	$2.70	$1.65	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	18.50	27.50	2.25	3.50	2.75	2.50	3.00	3.00	.50	30.00
Birmingham	18.75	27.375	4.40	4.52	....	2.84	2.70	2.70	.40	34.50
Boston	18.50	27.00	1.75	2.50	2.31	2.00‡*h*	3.30‡*q*	3.30‡*q*	.25‡	21.00
Chicago	18.50	27.00	....	....	....	1.75‡	2.55‡*o*	2.55‡*o*	....	29.00‡
Cincinnati	18.50	27.00	....	3.15	1.90	2.21	2.26*o*	2.26*o*	37	34.00
Cleveland	18.50	27.00	3.00	3.00*a*	3.00	2.21	2.26*o*	2.26*o*	.31*y*	33.00
Dallas	18.50	27.00	....	4.05	....	2.69*q*	3.00*q*	3.15*q*	.90	45.00
Denver	18.50	27.50	2.40	3.20	2.30	2.625	2.625*q*	2.625*q*	.365	32.40
Detroit	18.50	27.00	2.00	3.00	1.75	2.25	2.25	2.25	.50	25.00
Kansas City	18.50	27.125	3.30*g*	3.55*g*	3.16*g*	3.00	3.25	3.50	.54	.....
Los Angeles	18.75	27.50	3.20	4.60	4.00	2.80	1.90*e*	*l*	.60	*l*
Minneapolis	18.50	26.13*m*	....	....	....	2.10*im*	2.15*him*	2.15*him*	.37*m*	28.00*rm*
Montreal	.....	.....	2.90*p*	4.20*p*	3.62*p*	2.85*t*	2.58*tf*	2.07*tf*	.68*t*	1.85*td*
New York	18.50	27.00	3.45	....	3.45	2.10	2.15*o*	2.15*o*	.30*s*	26.00
Philadelphia	18.50	27.00	1.75/2.00	2.40	1.70	2.54	2.94	2.94	.37	26.00
Pittsburgh	18.50	27.00	1.98	2.50	1.90	2.32	2.37*o*	2.37*o*	.37	31.00
St. Louis	18.50	27.00	....	....	....	2.66	2.66	2.66	.38	29.00
San Francisco	18.75	27.25	1.80	2.75*n*	1.35	2.27*x*	3.30*aa*	....	.38*bb*	.....
Seattle	18.75	27.50	2.95*m*	2.95*m*	....	3.00*mq*	3.07*hm*	....	.48*m*	35.00*jm*

‡ Delivered. Note: Red lead in oil 50c higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* 15 lb per square. *f* Per 432 sq. ft. *g* 55 gal. can. *h* Per roll. 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per cwt. *l* Not used. *m* 1% discount for cash. *n* May, 1941 price. *o* Per 60-lb. roll. *p* Tax included. *q* Per 90-lb. roll. *r* F.o.b. factory Chicago. *s* ASTM Spec. D266-41. *t* Federal tax included. *w* Price to large paint contractors is $1.25 less. *x* Mineral surfaced. *y* 55-gallon container. *z* Drums. *aa* Approximate cost per 100 lbs. *bb* 55-gallon drums.

SKILLED AND COMMON WAGE RATES — PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Electrical Workers	Steamfitters	Common Labor Building	Common Labor Heavy Const.
Atlanta	$2.00	$1.65	$2.00	$2.00	$2.00	$1.80	$2.00	$0.75	$0.85
Baltimore	2.25*b*	1.95	2.15	1.625/2.00	1.90	2.00	2.00	1.10	1.10
Birmingham	2.00	1.625	1.75	1.50/1.75	1.875	2.00	1.875	.75	.85
Boston	2.15	1.90	1.95	2.25	2.00	2.15	2.00	1.40	1.40
Chicago	2.20	2.15	2.20	2.15	2.225	2.15	2.15	1.50	1.50
Cincinnati	2.25	1.975	2.10	2.00	2.125	2.00	2.125	1.25	1.15
Cleveland	2.25	2.125	2.25	1.875/2.125	2.125	2.125	2.125	1.50	1.40
Dallas	2.00	1.625	1.75	1.75	1.875	1.875	1.875	.90	.90/1.25
Denver	2.25*b*	1.875	1.875*b*	1.875*b*	2.25	2.05	2.05	1.275	1.35
Detroit	2.25	2.025	2.25	2.25	2.34	2.25	2.165	1.425	1.425
Kansas City	2.25	1.90	2.05	2.125	2.25	2.025	1.875	1.325	.90
Los Angeles	2.25	1.90	2.25	2.00	2.50	1.875	2.00	1.25	1.25
Minneapolis	2.075	1.80	2.00	1.85	2.25	2.06	2.00	1.30	1.30
New Orleans	1.9375	1.50	1.875	1.75	1.875	2.00	2.05	.80	.80
New York	2.75*b*	2.50*b*	2.75	2.75*b*	3.00*b*	2.25	2.75	1.50	1.50
Philadelphia	2.40/2.50	2.00	2.40	2.25	2.25	2.25	2.25	1.10	1.10
Pittsburgh	2.50	2.25	2.25	2.25	2.25	2.25	2.25	1.15	1.15
St. Louis	2.25	1.95/2.20	2.25	2.40	2.25	2.25	2.125	1.35	1.35
San Francisco	2.50	2.00	2.25	2.00	2.25	2.25	2.25	1.40	1.40
Seattle	2.235	1.935	2.135	1.95	2.235	2.135	2.34	1.535	1.45
Montreal*	1.17	1.06	1.11	1.00	1.17	1.11	1.11	.73	.73

b 7 hr. day. * Cost of living bonus now included in basic wage.

MEXICO CITY PRICES

In Pesos, f.o.b. City		July '47	Aug. '47
Common Wages—Building (8 hr. day)	av. per hr.	.57	.57
Common Wages—Heavy Const. (8 hr. day)	av. per hr.	.75	.75
Skilled Labor Wages			
Carpenters (8 hr. day)	av. per hr.	1.25	1.25
Bricklayers (8 hr. day)	av. per hr.	1.25	1.25
Struct. Iron Workers (8 hr. day)	av. per hr.	1.50	1.50
Struct. Steel Shapes 3"-15" x 12 meters	per ton	850.00	850.00
Reinf. Steel, Corr. Rods ⅜" x 12 meters	per ton	940.00	940.00
½" x 12 meters	per ton	895.00	895.00
⅝" x 12 meters	per ton	880.00	880.00
¾" x 12 meters	per ton	880.00	880.00
⅞" x 12 meters	per ton	870.00	870.00
1" x 12 meters	per ton	865.00	865.00
Gravel, truck load of 3½ cu. meters			
Blue Gravel	per tr. load	35.00	35.00
Rose Gravel	per tr. load	32.00	32.00
Cement, Std. Port. (Tolteca)	per ton	120.00	120.00
Lumber			
Mex. Sacred Fir (Oyamel)	per M ft.	375.00	370.00
1st Class Pine	per M ft.	750.00	800.00
2nd Class Pine	per M ft.	450.00	550.00

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $2.101. **ENR Common Average:** $1.221.

LOOK FOR THE PIPE
WITH THE RED SPIRAL STRIPE
GENERAL ELECTRIC COMPANY HANGAR
SCOTIA, N. Y.
Marcus T. Reynolds, Architect
J. L. Ottenheimer, Heating Engineer
Heating Maintenance Corp., Heating Contractor

Another Big Hangar uses RADIANT HEATING *with* BYERS WROUGHT IRON PIPE

With a floor area 168'8" square, a roof 45' above grade at its high point and 17' at the eaves, and large, frequently-opened access doors, this hangar, like all such structures, presented a difficult heating problem. The designers solved it with radiant heating, which has been successfully used in a number of similar applications.

The floor area is divided into 20 individual heating sections, each with a sinuous coil of 1¼" wrought iron pipe, welded and cold-bent to shape, embedded in an 8" concrete floor slab. In the sections along the sides and across the front, the pipe was spaced on 12" centers. In the remainder of the floor 24" spacing was used. Welding operations on the coils were facilitated by raising each individual coil a few feet off the floor with tripod-mounted hoists.

To provide a level base, a 1½" rough concrete slab was first poured on the fill. Reinforcing rods were laid and angle iron supports placed above them, on which the coils rested. This positioned the pipe at approximately the neutral axis of the slab. Hot water is supplied to the system from two U-type heat exchangers, which are fed with steam at 5-lbs. pressure by two oil burning boilers. Two single-stage centrifugal pumps circulated the water. Temperature is controlled by a combination indoor-outdoor thermostat.

The use of wrought iron follows established engineering practice. For ten years, A. M. Byers Company has been collecting data on radiant heating as a service to designers, and has detailed information on a thousand or more installations. Over 90% of these use wrought iron . . . and evidence indicates that the same proportion holds for the many thousands of other installations. Wrought iron's ease of fabrication, its high heat emission, its favorable thermal characteristics, and its demonstrated corrosion resistance make a vital contribution to a successful system. Ask for our bulletin, "Wrought Iron for Radiant Heating."

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco.

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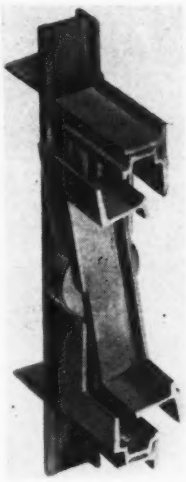
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

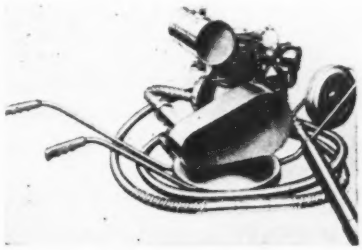
New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

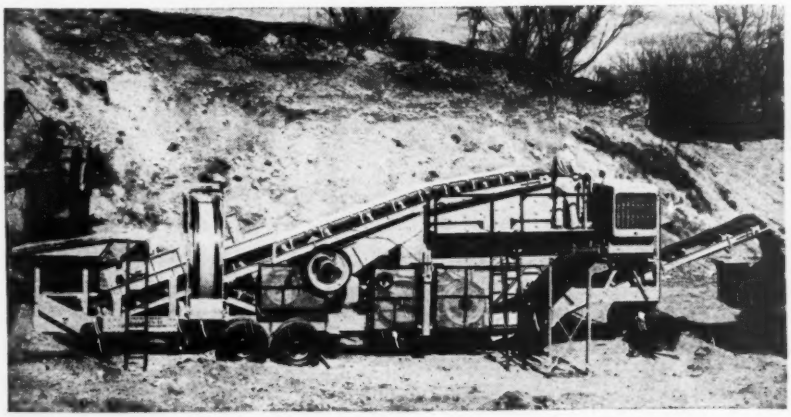
ALUMINUM FOIL—A "Honeycomb" material is a lightweight, extremely strong "sandwich" material formed of a core whose cross-section resembles that of a beehive and to the edges of which are bonded sheets of metal, wood, plastic or other semi-rigid material. The metal-faced, metal-core Honeycomb sandwich likewise presents an unsinkable structure, since it contains numerous individually sealed air chambers. It would still float if 80 per cent of the cells were perforated, which is improbable, as there are up to 800 cells per ft., which will support four lb. of weight without sinking. The foil's thickness is from two one-thousandths to four one-thousandths of an inch. The adhesive developed in conjunction with the core has made possible the success of the product, as it holds the corrugations of the core together and then binds the thin edges of the core to the facing material. Thermosetting and processing considerable insolubility in organic solvents, this adhesive combines extremely high shear and tensile strengths at low and elevated temperatures. Experiments are being conducted to use the adhesive as a substitute for riveting, spot welding and a number of other purposes. Glued double-skin corrugations appear to be especially attractive and this field is being thoroughly explored.—*The Glenn L. Martin Co., Baltimore, Md.*

FACTORY SASH—Hope's Lok'd Bar steel factory sash is designed for greater strength and weathertightness in industrial buildings having large glazed wall areas, and for longer life under conditions of exposure and corrosion. Vertical sash bars are bulb tee sections approaching the I-beam type of section in strength. In the "Lok'd Bar" joint, the flat tee horizontal muntin is threaded through the bulb tee. Ventilators are complete casement and frame units, solid welded at corners. Ventilator sections are rolled in one piece with the weathering flanges integral, air infiltration is less than 1 cfm air at 25 mph. wind pressure.—*Hope's Windows, Inc., Hopkins Ave., Jamestown, N. Y.*





CONCRETE VIBRATOR—Powered by Model AKS Wisconsin 4-hp. air-cooled engine, this vibrator, specially built for heavy duty work, has automatic clutch which engages at engine speed of 1,700 rpm. Rugged flexible shaft has ½-in. core of stranded music wire. Vibrating head is 2⅜-in. dia. by 18½ in. long. Engine swivels independently of stand, which has rubber-grip wheelbarrow handles and rubber puncture-proof tire. Jack shaft is equipped with two double row radial thrust ball bearings. Vibrating speed is 8,000 rpm. Complete unit with 21-ft. flexible shaft weighs 200 lb.—*Aristo Power Tools, Inc., 601 W. Washington Blvd., Chicago 6, Ill.*



PORTABLE GRAVEL PLANT—Portable crushing, screening and loading plant features TwinDual roll crusher, which is a two-stage secondary crusher in one machine. It consists of two sets of different diameter rolls mounted on common roll shafts and operating simultaneously. Primary crusher is 10x24-in. jaw crusher and twin secondary is 24-in. TwinDual roll crusher. The 3x10-ft., 3½-deck roller bearing gyrating screen is mounted on an incline. Thirty-inch conveyors are used. Gooseneck carrying-truck is of 12-in. channel frame construction with 12 pneumatic tires. Without power, unit weights 47,820 lb. Moving and operating height is 12½ ft., length is 46 ft. overall, width is 8 ft.—*Universal Engineering Corp., Cedar Rapids, Iowa.*

MATERIALS TESTING COMPUTER—A new device of service to engineers in every field where materials must be physically tested makes use of a hand-size computer, with much information at fingertip view. Instead of calculating the specimen cross-sectional area, then multiplying this area times the psi. to get breaking strength, engineers need only set the computer at specimen size, then read the breaking strength opposite the psi. They can find area, or the psi., quickly. The computer covers rectangular specimens from 1/32 to ¼ in. thick by ½ in. to 1-½ in. wide, from 0 to 150,000 lb. psi; the reverse side of the computer covers rounds from 1/16

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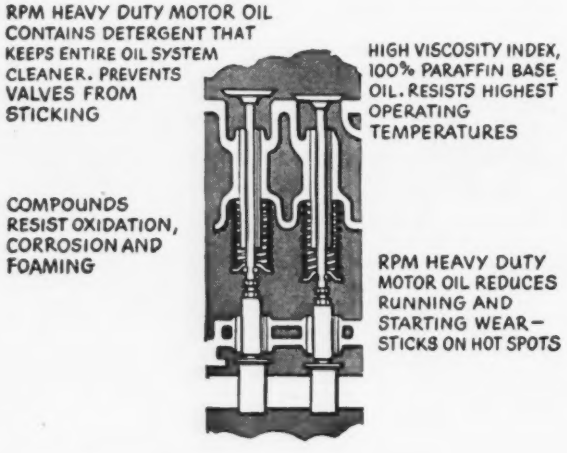
RPM Heavy Duty Motor Oil has a one hundred per-cent pure paraffin base. It will resist the highest operating temperatures.


RPM HEAVY DUTY MOTOR OIL CONTAINS DETERGENT THAT KEEPS ENTIRE OIL SYSTEM CLEANER. PREVENTS VALVES FROM STICKING
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COMPOUNDS RESIST OXIDATION, CORROSION AND FOAMING
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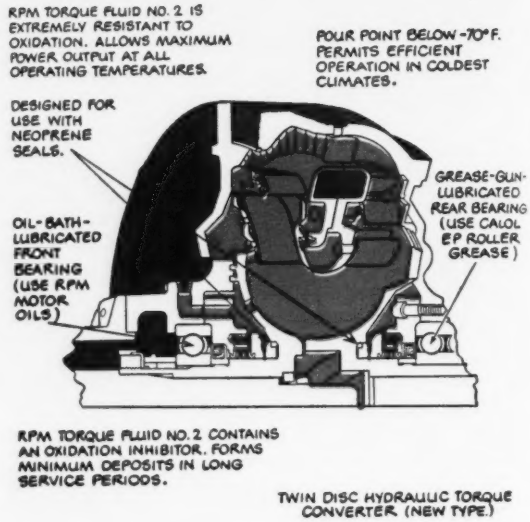
CARRIES CONTAMINANTS AWAY WITH DRAININGS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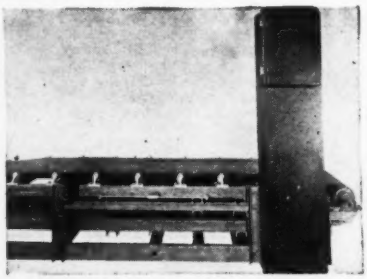
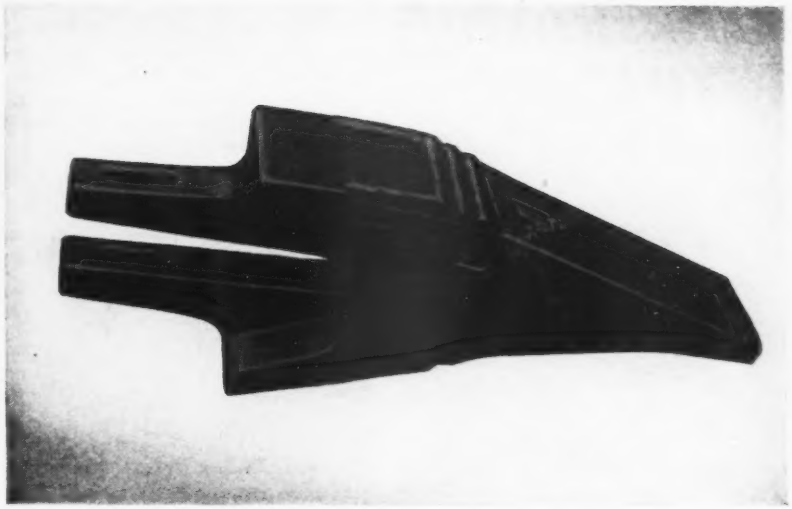
to 1 in. dia. up to 100,000 lb. psi. It may be had without cost by engineers submitting their full name, company, and position. Professors in high school and college may likewise obtain free computers—*W. C. Dillon & Co., Inc., 5410 W. Harrison, Chicago 44, Ill.*

WATERPROOFING MEMBRANE—Glasfab, inorganic, rot-proof waterproofing membrane consisting of open-mesh fabric woven of Fiberglas yarns, is designed for roofing applications, for waterproofing brick or concrete walls above or below grades, and for other waterproofing jobs. Open mesh permits full impregnation by waterproofing compound. Impregnated fabric adheres firmly to rough or irregular surfaces, molding itself to contours. Glasfab has strength factor with warp of 64 lb. per inch-wide strip and 92 lb. with fill per inch-wide strip. Thread count is 24 threads per inch for both warp and fill. Yarn is made by *Owens-Corning Fiberglas Corp.* of Toledo.—*Lexington Supply Co., Cleveland, Ohio.*

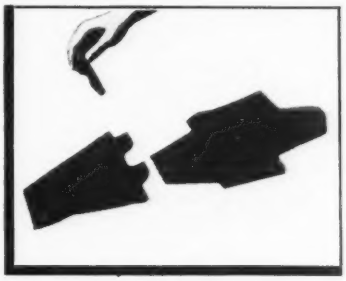


CONVEYOR BELT METER—Conveyoflo meter utilizes diaphragms instead of usual knife-edge-beam principle for metering flow of dry materials by weight. Scales may be used to proportion and control, as well as weigh, feed of one or more dry materials and to control flow of liquids in proportion to flow of dry materials. Cyclometer type totalizer reads directly in any unit desired and is automatically corrected for any belt speed variations.—*Builders-Providence, Inc., Providence, R. I.*

RADIAL SAW—Ball-bearing roller head of new radial saw allows blade to move smoothly and evenly into work.



Faster Digging with *ESCO* Box Points and Adapters



Box-type point fits perfectly to adapter; is locked to adapter by alloy steel pin, which is held in place by rubber keeper.

Fits all popular make Dipper, Dragline, or Hoe Buckets and Rippers

Faster digging, with sharp teeth that stay sharp, is yours when you install a set of *ESCO* box type renewable point teeth. Maintenance cost is low, and loss of time caused by tooth trouble is practically eliminated.

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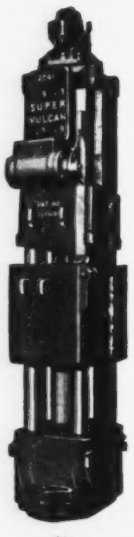

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Ram-type arm, moving through roller head, frees work table for shifting of material and gives operator clean, unobstructed view of all layout marks. To change from cutoff to rip requires about 3 sec.—*Construction Machinery Sales Co., Waterloo, Iowa.*

TANDEM ROLLER—This 3 to 4-ton, 36-in. wide compaction roller compacts within 1½ in. of left edge of frame. Wheel base is 7 ft. 10 in. Unimpaired vision of steering roller is provided. Brake horsepower of 27.8 is furnished by Allis-Chalmers, Hercules or Continental engine at 1,800 rpm. The ¾x6-in. steel frame is securely braced by five additional steel cross members and steel deck, providing perfect gear shifting and shaft alignment.—*Wheeler Roller Division, Shaw Sales & Service Co.*, 5100 *Anaheim-Telegraph Rd., Los Angeles 22, Calif.*

TRACK JACK—Designed to facilitate rail maintenance, new Type-A jack provides new pawl and socket design that is said to cut maintenance 81 percent, make lifting 31 percent easier, give greater protection to operator and provide larger striking surface. Features include full-rated lifting capacity on cap and toe, electroded gibs, hardened steel wearing plate and spring-backed pawls.—*Templeton, Kenly & Co.*, 1020 *S. Central Ave., Chicago 44, Ill.*

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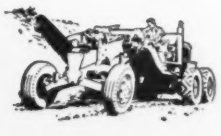

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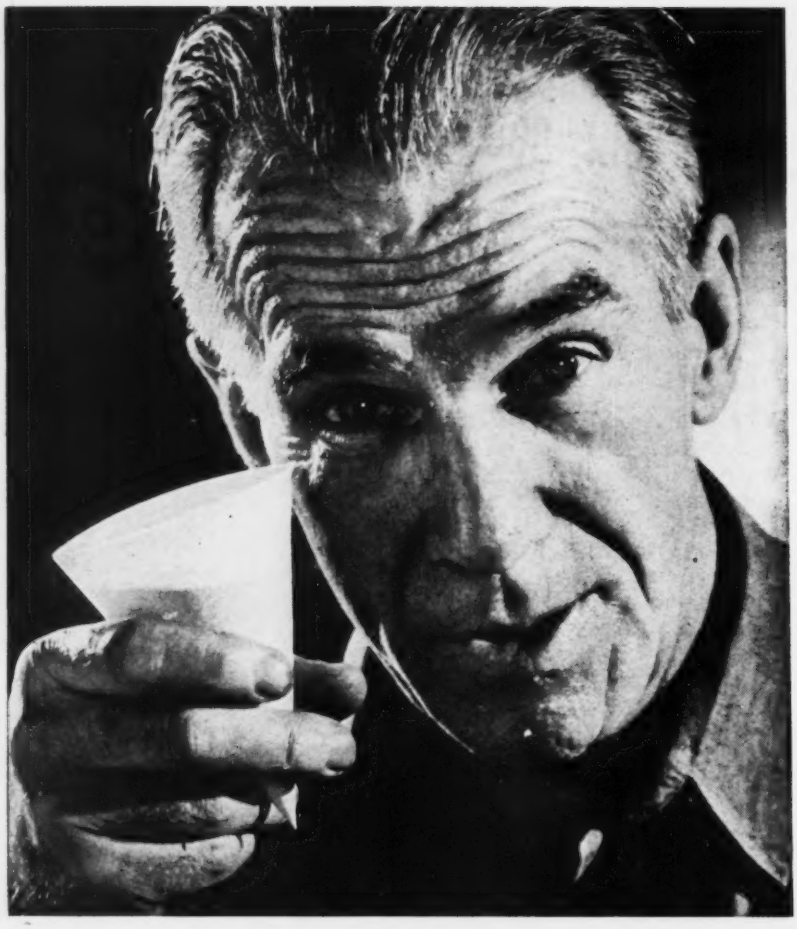

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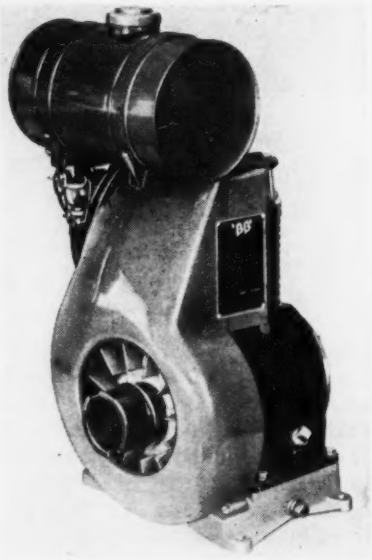
TRACTOR - SCRAPER — Unit, designated as Primemover, consists of two wheeled. rubber-tired tractor, joined to scraper by pedestal hitch. Tractor is equipped with 225-hp. diesel engine and large Goodyear Sure Grip tires. High rate of drawbar pull in fourth gear results in high average haul speeds when loaded. Scraper is positive forced ejection type, operated by air actuated cable power unit, mounted on rear of tractor and deriving its power from main engine. Steering is accomplished by two double-acting hydraulic jacks. Unit is equipped with four air-actuated brakes.—*LaPlant-Choate Mfg. Co., Cedar Rapids, Iowa.*



LOW HP. GASOLINE ENGINE—The second model of the Gladden "Bee-Line" engines is now in production. Designated as Model BB, it has a power range of 2.5 to 4.3 hp. The engine is of clean-cut, compact design, the overall height, including gas tank, being only 23 in., the width 15½ in., and length of 14 in. Only 2.9 cu. ft. of space is required. Operating parts are made of the newer types of tough alloys proved

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Sulmet Bit after drilling 360 feet

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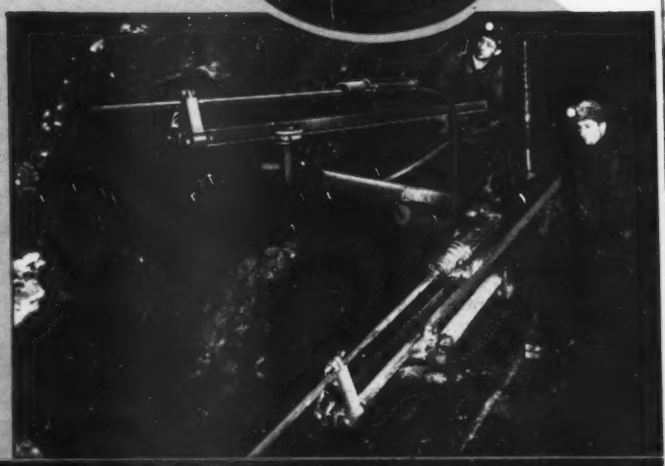
The Sullivan Hydro Drill Jib is designed especially for drilling with a long feed—6 feet or more. Now with Sulmet Bits you can get the same economy of drilling in the harder rocks, because you can bottom the hole with a single Sulmet Bit.



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No matter what the enterprise, or where it is located, the danger of its destruction by fire is always present.

That's a harsh statement, yet undeniably true, for every day we read of enormous losses resulting from fire.

But there is another side to this picture of fire destruction. We call it the "Automatic" Sprinkler side. For the concentrated effort of our technical and engineering departments has resulted in *fire protection that really protects* . . . no matter what the hazard.

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—a famous member of the "Automatic" Sprinkler Family. Provides adequate protection for quench tank, transformer, oil line and other fires of flammable liquid origin.

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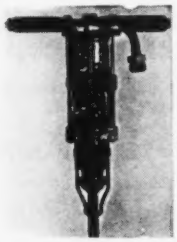
"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN 1, OHIO
OFFICES IN PRINCIPAL CITIES OF NORTH and SOUTH AMERICA

best by aircraft engine experience.—*Gladden Products Corp., 635 W. Colorado Blvd., Glendale, Calif.*

CRAWLER CRANE—New model 4500 is largest crane built by Manitowoc. Specifications are: Crawler length — 25 ft.; overall crawler width—20 ft.; crawler tread width—48 in.; tail swing radius—18 ft. 5 in.; weight machine without boom — 275,000 lb.; working load at 20-ft. radius—100 tons; height to top of cab—12 ft. 11⅝ in.; swing speed — 2.2 rpm.; travel speed — .77 mph.; line speed hoist—210 ft. per min.; line pull hoist—41,500 lb.; line speed drag—142 ft. per min.; line pull drag — 65,000 lb.; 4-yd. drag — 140 ft. boom, 120 ft. radius; 3½-yd. dipper on 60 ft. shovel boom, 45-ft. sticks; 4-yd. dipper on 55-ft. shovel boom, 41-ft. sticks; 5-yd. dipper on 30-ft. shovel boom, 20-ft. sticks. Machine can be shipped on flatcars by removing crawler frames and unloaded in about 1½ days.—*Manitowoc Engineering Works, Manitowoc, Wis.*

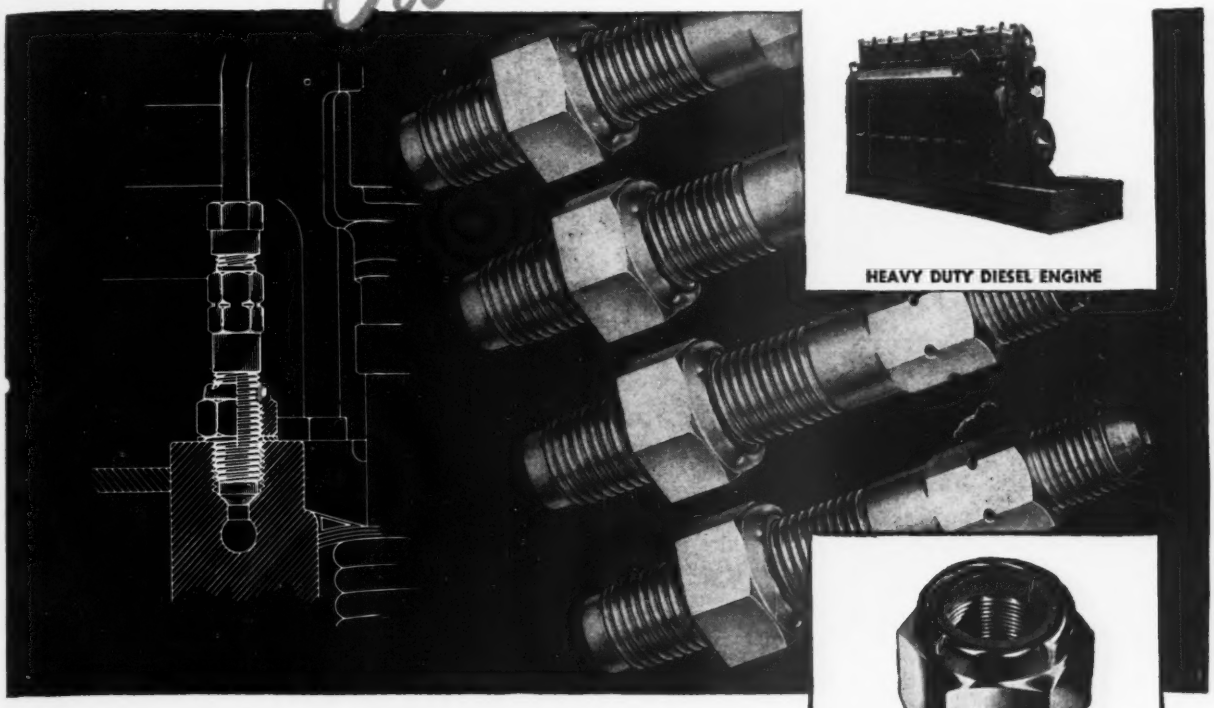
LIGHTWEIGHT ROCK DRILL—J30 Jackhamer is designed for drilling medium to hard rock and concrete. Three-in-one backhead allows machine to be easily converted to any one of three types, wet, dry, or blower type. In addition, it has new sealed throttle valve, stronger rifle bar, two-piece chuck and long-wearing piston.—*Ingersoll-Rand, 11 Broadway, New York 4, N. Y.*



FINGER GUARD—In addition to protecting fingers and thumb on face and

(*Continued on page* 150)

SELF-SEALING *Prevents Oil Seepage* **ALONG FUEL LINE STUDS**



HEAVY DUTY DIESEL ENGINE

LOOK FOR THE RED COLLAR
THE SYMBOL OF SECURITY

It is threadless and permanently elastic. Every bolt — *regardless of commercial tolerances* — impresses (does not cut) its full thread contact in the Red Elastic Collar. This threading action produces a compressive, radial-reactive pressure against *both* the top and bottom sides of the bolt threads . . . insures a permanently tight, full contact between the bolt and nut threads . . . and makes all Elastic Stop Nuts self-sealing against Liquid Seepage.

As a result, all Elastic Stop Nuts protect permanently against thread corrosion and resultant failure.

The Red Elastic Collar seals the threads tight against LIQUID SEEPAGE

Three important benefits result from the use of ESNA Elastic Stop Nuts on Diesel engine fuel line studs. *First,* operational safety. The Red Elastic Collar is self-sealing against fuel oil operating pressures up to 60 psi. *Second,* design simplification. The Red Elastic Collar is self-locking anywhere on the stud. It permits the use of straight threads—instead of individually gauged tapered threads—for the oil supply block connection. *Third,* faster assembly. Straight threads permit the accurate positioning of the studs between the block and fuel line—before the finished surface of the Elastic Stop Nut is fully seated and self-locked and self-sealed against the copper washer. The total result? Threefold economy!

Multiple protection — against Liquid Seepage, Vibration, Corrosion, Thread Failure and Costly Maintenance — has made Elastic Stop Nuts the standard fastener on many products. Standardization achieves the double economy of inventory simplification and reduced procurement costs. For further information address: Elastic Stop Nut Corporation of America, Union, New Jersey. Sales Engineers and Distributors are located in principal cities.

ESNA
TRADE MARK

ELASTIC STOP NUTS

INTERNAL WRENCHING

ANCHOR

INSTRUMENT MOUNTING

SPLINE

CLINCH

GANG CHANNEL

CAP

PRODUCTS OF: **ELASTIC STOP NUT CORPORATION OF AMERICA**

Worthington-Ransome Blue Brute Distributors

See ad on page 133 for list of equipment in each line

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Ala., Birmingham, Construction Equipment C.
Alaska, Anchorage, Airport Mach. & Storage Co
Ariz., Phoenix, Lee Redman Equipment Co.
Ark., Fort Smith, R. A. Young & Son
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Ida., Boise, Olson Manufacturing Co.
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Iowa, Cedar Rapids, McNall Mach. & Supply Corp.
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St. Louis, W. H. Reaves
Montana, Billings, Interstate Truck & Equip. Co.
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Nevada, Elko, C. W. Paul Hardware and Machy. Co.
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N. J., No. Bergen, American Air Comp. Corp.
N. M., Albuquerque, Bud Fisher Co.
Boswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Co.
New York, Hodge & Hammond, Inc.
New York, Railroad Materials Corp.
Syracuse, Milton-Hale Mach. Co.
N. C., High Point, Smith Equip. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.

Ohio, Cincinnati, Carroll-Edwards & Co.
Dayton, Carroll-Edwards & Co.
Toledo, The Kilcorse Machy. Co.
Okla., Oklahoma City, Tattan-Douglass Equip. Co.
Oregon, Portland, Andrews Machinery

Pa., Wilkes-Barre, Ensminger & Co.
Mechanicsburg, American Equip. Corp.
Philadelphia, Metalweld, Inc.

S. C., Columbia, Smith Equipment Co.

Tenn., Knoxville, Dempster Bros., Inc.
Memphis, Independent Tractor Co.
Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Dallas, Shaw Equip. Co.
Houston, So. Texas Equip. Co., Inc.
San Antonio, Patten Machy. Co.
Tyler, D. M. McClure Equip. Co.

Utah, Salt Lake City, J. K. Wheeler Mach. Co.

Va., Richmond, Highway Machy. and Supply Co.
Vt., Barre, A. M. Flanders, Inc.

W. Va., South Charleston, Allied Equip. Co.
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Toledo, The Kilcorse Mach. Co.

Pa., Allentown, H. N. Crowder, Jr., Inc.
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Texas, El Paso, Equip. Supply Co.

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BUY BLUE BRUTES

Worthington Pump and Machinery Corp.

Worthington-Ransome Construction Equipment Division

Holyoke, Massachusetts

MEN AND JOBS

Fred T. Ley, chairman of the board of directors of Frey T. Ley & Co., Inc., 30 E. 40th St., New York City has announced that **Charles M. Chuckrow,** formerly executive vice-president, has returned to the organization and has been elected president. Mr. Chuckrow was recently associated with the Tishman Realty & Construction Co., Inc., with whom his principal activity was the development and construction of the new office building on the easterly block front of Park Avenue, 56th to 57th Streets, New York City.

C. M. Chuckrow

Frederick A. Ley and Theodore M. Ley, sons of Fred T. Ley, have been elected vice-presidents. Also returning to the company will be several key employees who, together with Mr. Chuckrow, were engaged in the construction of such outstanding structures as the 70-story Chrysler Building, the Fisk Building at Columbus Circle, the Croyden Hotel occupying the block front of Madison Avenue and 85th and 86th Streets, the cooperative apartment houses at 820 Fifth Avenue, 990 Fifth Avenue and 290 Park Avenue and many others of a similar nature.

Mr. Chuckrow, who joined the Ley Company shortly after his graduation from Cornell in 1911, resigned in 1933 to become president of the Fred F. French Co. During his incumbency that company constructed Knickerbocker Village and Interlaken Gardens. With the late Fred F. French he organized the Fillmore Construction Co. Ltd. of London, England.

Simeon Ross has resigned as chief engineer of the Del Balso Construction Corp. to become president of the Eureka Concrete Corp., contractors and engineers at 1339 Atlantic Ave., Brooklyn, N. Y. Associated with Mr. Ross as secretary-treasurer is Stanley Sobocha, formerly treasurer of the Eureka Fireproofing Co. Inc.

Richard W. Williams has retired after almost half a century of service with the Corps of Engineers, Portland, Ore., district. At the time of his retirement he was head of the supply division. Williams served under 23 district engineers during his long connection with the corps, working on projects at Astoria, The Dalles, Reedsport and on the upper Columbia and Snake Rivers. He became head of the supply division in 1937 during the construction of Bonneville Dam.

Appointment of **Guy C. Cleaver,** of Big Run, Pa., as project engineer for the Pennsylvania Department of Highways in the Indiana, Pa., district has been announced.

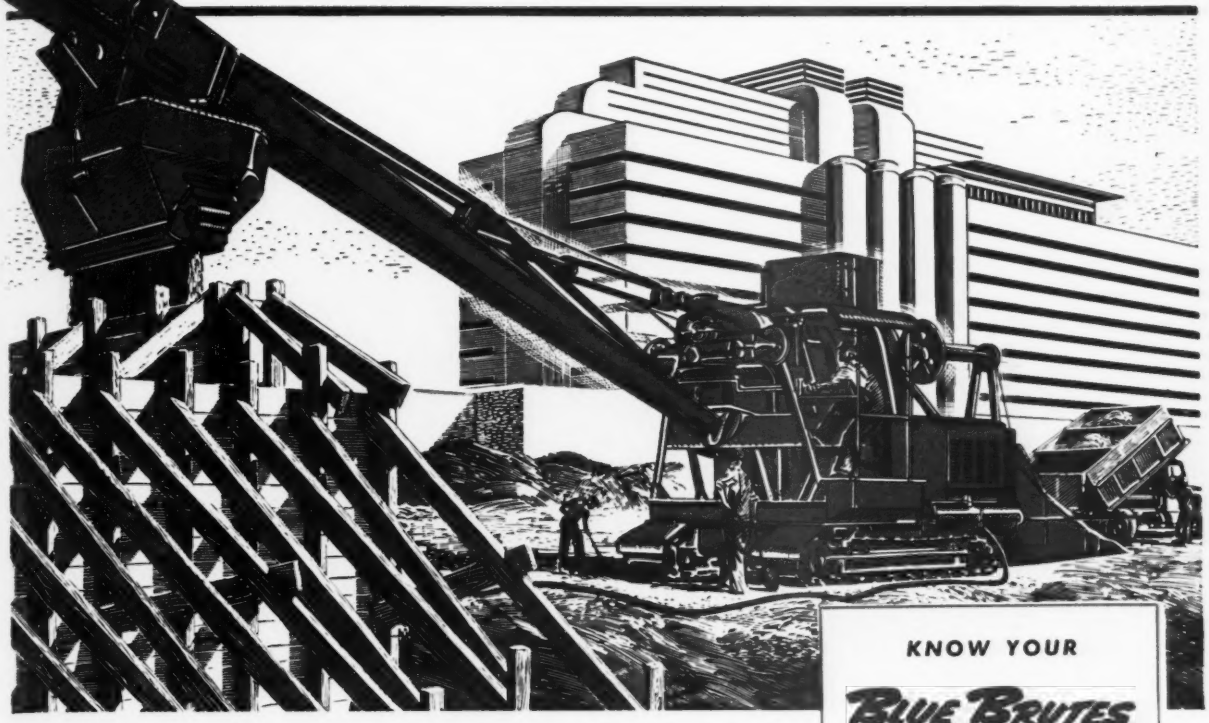
Elmer C. Lawton, chief engineer of the Rochester, N. Y., district of the State Department of Public Works, has announced the appointment of Henry Ten Hagen of Warsaw as director of highway maintenance for the district. Mr. Ten Hagen will relieve Herbert L. Michael, deputy to Mr. Lawton, of maintenance supervision in the district.

Lt. Col. Delbert B. Freeman, Omaha, Neb., district U. S. Army Engineers, and Lt. Col. Stanley G. Reiff, executive ocer of the Missouri River division office, were recently assigned to the Far East command at Yokohama.

E. L. Worthington resigned as West Virginia Road Commissioner Aug. 15 to become chief engineer of roads for the reconstruction section of the American aid mission to Greece, and is now in Greece. His resignation followed 25 years of continuous service with the West Virginia Road Commission during which he held various supervisory positions. He was named commissioner Feb. 1, 1946, after serving as state maintenance engineer for eight years.

Clarence Blair Associates, Inc., consulting engineers, New Haven, Conn., announce that **Joseph A. Novaro** has been admitted to membership in the firm. Mr. Novaro joined the organization in 1928. As a reserve officer he was ordered to active duty with the Corps of Engineers in July, 1941, and was assigned in succession to the Puerto Rico district engineer office and to the Antilles division engineer office in San Juan, Puerto Rico. Successive assignments were designer of tank farm installations; chief of the inspection division; area engineer of the San Juan area; water supply officer and engineer member of the Puerto Rico Sector malaria board. His final

GOING UP! FOR A NEW HIGH IN VERSATILITY



In the Ransome 34E Blue Brute Paver, with elevated boom attachment, you have a mobile, all-purpose mixing plant that can take a lot of *different*, off-highway jobs in its stride.

High foundation walls, isolated bridge piers and other hard-to-get-at spots are easily reached by the fast-swinging "live" boom that raises the discharge bucket to a 20-ft. clearance. And the positive hydraulic operation of both boom and bucket assures exact pouring-control, eliminating the need — and the risk — of a man to manually discharge the bucket at the top of a high form or batch hopper.

More Ransome Advantages

Features like these — automatic bucket-lock that prevents accidents when operating with elevated boom; unobstructed bucket opening that eliminates segregation; wide, long crawlers that go almost anywhere regardless of mud, sand or rough ground — all pile up proof that Ransome 34E Pavers, Single Drum or Dual Drum, can go farther, do more work faster, and cut costs every foot of the way.

Write for *all* the facts. Learn why *there's more worth in a Blue Brute.*

R7.8

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BLUE BRUTES

Your Blue Brute Distributor will be glad to show you how Worthington-Ransome construction equipment will put your jobs on a profitable basis. His name is listed on Page 132.

RANSOME EQUIPMENT

Pavers, Portable and Stationary Mixers, Truck Mixers, Pneumatic Placing and Grouting Equipment and Accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Self-Priming Centrifugal Pumps and Accessories.

WORTHINGTON

Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division, Holyoke, Mass.

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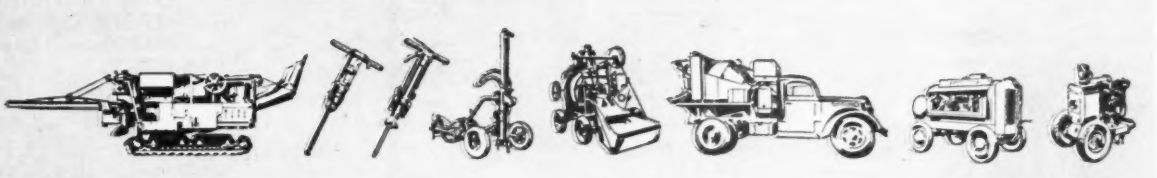

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New indispensable Equipment for Contractors, Railroads, Mines and all public and private Construction Departments.

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The Prehy Co., Inc. 420 LEXINGTON AVE NEW YORK 17, U.S.A.

assignment was as project engineer on new water works facilities for San Juan. Mr. Novaro was released from active duty in August, 1946, with the rank of lieutenant colonel.

Ben F. Rush, former public works superintendent of the territory of Hawaii, has resigned to take a newly-created position of director of harbor facilities. He will direct a harbor improvement program of nearly $7,000,00 authorized by the 1947 Hawaii legislature.

B. F. Rush

His successor as public works superintendent, appointed for a 4-year term by Gov. Engram M. Stainback, is his former assistant **Robert M. Belt.**

Mr. Rush was a lieutenant with the Army Engineers in World War I and a commander in the Navy in World War II. As a Navy engineer officer, he worked on some of the massive Pearl Harbor underground construction projects, including the Red Hill underground oil storage depot, largest of its kind in the world. Between the wars and since 1943 he has held various public engineering positions throughout Hawaii.

R. M. Belt

Mr. Belt also was a wartime Navy commander, assisting in the Pearl Harbor construction program. He first joined the T. H. public works department in 1931. Both he and Mr. Rush received Navy commendations for their work.

Two new positions of assistant state highway engineer have been created by the Oregon State Highway commission and two highway department staff engineers have been elevated to fill them. **W. C. Williams,** Portland division engineer, and **William W. Stiffler,** assistant maintenance engineer, have been appointed first and second assistant highway engineers, respectively. The two assistants will have charge of all details of highway building and maintenance, leaving State Highway Engineer R. H. Baldock free for overall supervision of the department. Williams will have charge of design and construction and will act as state highway engineer in the absence of Baldock. Stiffler will supervise

maintenance and operation activities.

Mr. Williams has been with the department for 27 years. Before being transferred to Portland, he was head of the eastern Oregon division, with headquarters at La Grande. Mr. Stiffler has been with the department for 26 years. Before going to Oregon, he was connected with the Utah State Highway department and the city engineer's office at Salt Lake City.

Lt. Cmdr. R. J. Sipe of the U. S. Coast and Geodetic Survey, is directing a coast and geodetic survey project in the New Bern and Morehead City, N. C., area. His chief assistant is George Varnaboe, a civilian engineer.

Frank O. Lee has been appointed director of technical services for St. Petersburg, Fla., replacing Stanley Pinel, resigned. Lee was city director of public works 12 years prior to Aug. 23, 1943, when he resigned to enter private engineering practice. He is a graduate of the University of Vermont and served Barre, Vt., five years as city engineer and water superintendent. He later became chief engineer for G. L. Gregoire of Barre and constructed highways and bridges in the New England States for several years. He was employed by St. Petersburg as a supervising engineer in the construction of the Snell Isle bridge and was named city engineer and water superintendent. He has directed most of St. Petersburg's major public works projects. Under his supervision projects aggregating more than $3,000,000 have been constructed there.

Col. Herman H. Pohl, Corps of Engineers, U. S. Army, has been assigned to Wilmington, N. C., as district engineer, succeeding Col. Beverley C. Snow, who has been given a new assignment in the Pacific Area. A graduate of the U. S. Military Academy, Colonel Pohl took advanced work in engineering at Massachusetts Institute of Technology and served in both world wars. He participated in the North African and Normandy invasions and for a period in 1941 was commanding officer of the 96th Engineer Battalion at Fort Bragg, N. C. He recently has been serving on the headquarters staff as a member of the Regular Army integration board, personnel division, Office of the Chief of Engineers.

Walter L. Rice, civil engineer, has joined the provincial department of public works, Toronto, Ont., where he will work on the design of water supply and sanitary disposal units. He was 28 years with the works department of Toronto and has resigned as construction and engineering officer with the R.C.A.F. to accept the new position.

How to bring those distant suppliers closer to home

It's like having all your suppliers close at hand, when you specify Air Express delivery. Air Express gets you what's wanted in mere hours . . . no matter *where* your suppliers are located.

Planes carrying your Air Express shipments are bigger and faster today. Even overnight coast-to-coast deliveries are routine. Same day delivery between many airport towns and cities. And Air Express rates are *low*. Use this speedy, profitable service regularly to keep customers satisfied, and business running without a hitch.

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Trailer parts (51 lbs.) needed in Los Angeles *fast*. Picked up at Portland, Ore., factory 5 PM on 13th, delivered first thing next AM 821 miles away—*in time!* Air Express charge $12.52! Other weights, any distance equally inexpensive and *fast!*

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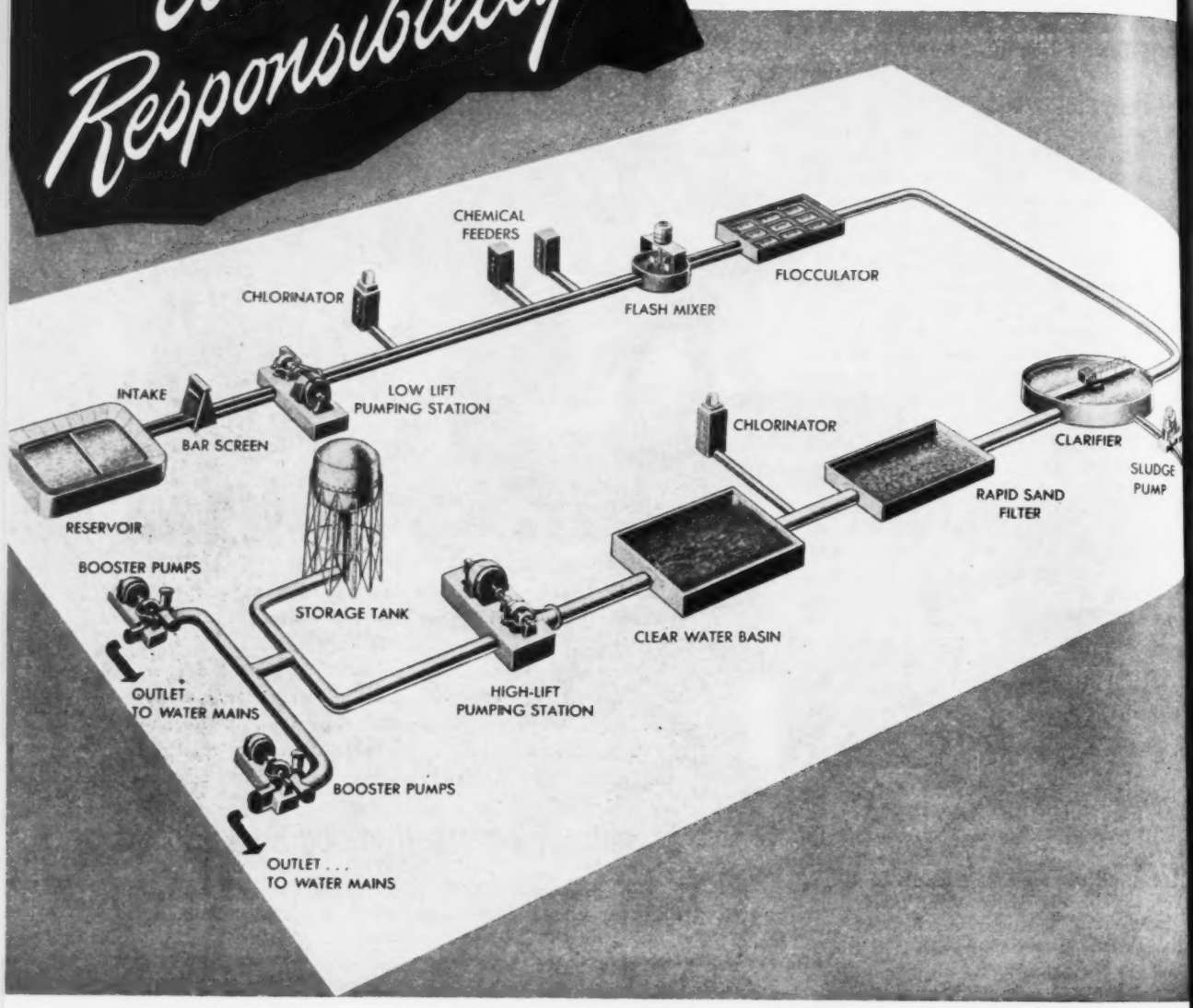

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Whether your plans call for expansion, modernization or a completely new plant, you will find advantages in using the Westinghouse background in waterworks engineering—regardless of the size of the contemplated project.

Westinghouse engineers will work with you to obtain highest operating efficiency through the proper *selection, application* and *co-ordination* of the complete electrical drive.

Westinghouse equipment will provide you assurance of long-time, trouble-free service.

Westinghouse servicing will minimize and simplify your maintenance problems.

Typical of case histories where Westinghouse waterworks engineering has been job-proved is the City of Dallas 120 mgd Bachman plant, which is completely Westinghouse-electrified.

For help on your waterworks drive problem, call your Westinghouse office, or write today to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-94746

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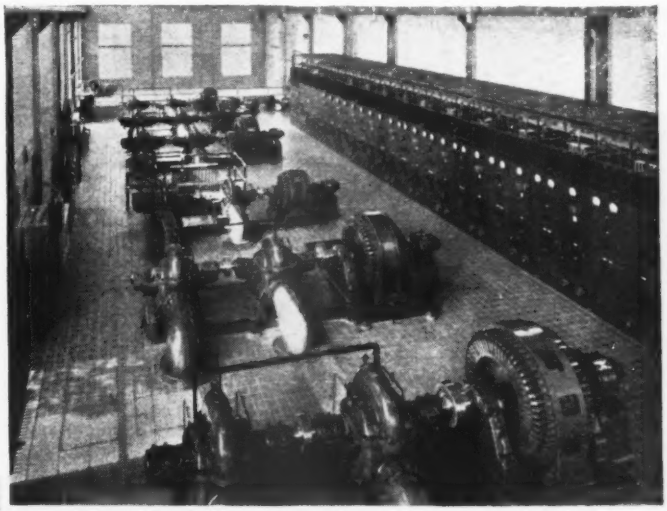
"WESTINGHOUSE-EQUIPPED THROUGHOUT" MEANS SIMPLIFIED ORDERING, QUICKER INSTALLATION, MORE EFFICIENT OPERATION

Putting power to work *efficiently* can be a major problem—or a simple one. When items must be selected, ordered and received from many sources, it means many chances for costly errors and delays . . . divided responsibility—or none at all—for performance of installed equipment.

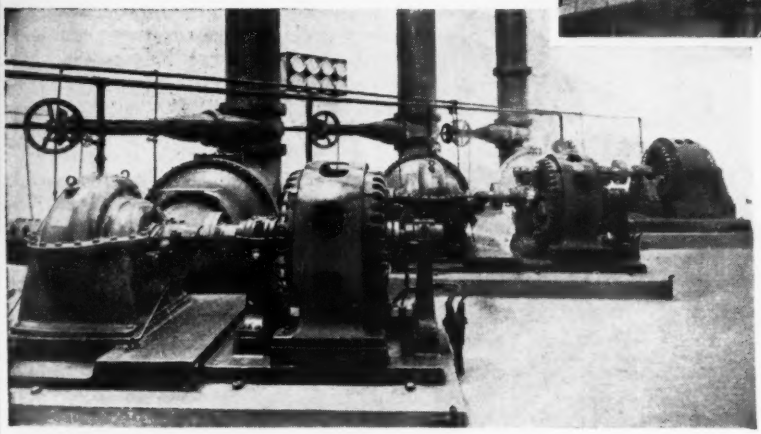
Westinghouse offers the way to simplify the job. From equipment for generation of electrical or steam power, to the most specialized types of drives and control for its utilization, Westinghouse provides a single source of supply . . . one broad pair of shoulders competent to take responsibility for performance of all parts of the job.

Here is one of many examples where Westinghouse unit responsibility is preventing headaches . . . saving money . . . assuring *higher operating* efficiency:



MAIN PUMPING FLOOR of the 120 mgd Bachman Waterworks, City of Dallas, Texas. This plant has 15,225 hp in Westinghouse motors, supplemented by Westinghouse switchgear and other apparatus. The satisfactory service rendered is evidenced by 12 years' operation without repairs of any kind to electrical equipment, with a maintenance cost which has averaged less than 2c per hp.

In the center are five 800-hp and one 400-hp Westinghouse synchronous motors. At the left and right-rear two Westinghouse motor generator sets (one of which is a standby unit) furnish excitation for four 500-hp and three 900-hp Westinghouse motors located in the basement. At the right is shown part of the Westinghouse controls for the entire plant.



LEFT: Basement floor, showing three of four 500-hp Westinghouse motors, each of which drive a 30 mgd raw-water pump. Three 900-hp Westinghouse vertical motors, driving clear-water pumps, are also located on this floor but are not seen in this picture.

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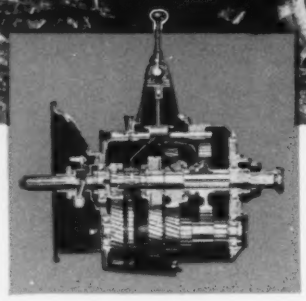

Model 4A86

Ruggedness and dependability demonstrated by Fuller Transmissions in a wide variety of heavy-duty material-handling jobs led the LaPlant-Choate Manufacturing Co., Inc., to select a version of Fuller's Model 4A86 Transmission for its new high-speed earthmover, the *Moto-Scraper*.

Proved performance characteristics of Fuller Transmissions enable them to transmit an adequate supply of power in the face of steep grades . . . heavy loads . . . clinging mud. Four forward speeds . . . ranging from 2.76 mph up to 18 mph . . . plus one reverse gear, provide ratios to handle every rugged combination of job conditions.

You can obtain this same ruggedness and dependability in other types of material-handling equipment by specifying geared-to-the-job and proved-in-the-field Fuller Transmissions and Auxiliaries.

FULLER MANUFACTURING CO., TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN

Unit Drop Forge Division, Milwaukee 1, Wisconsin
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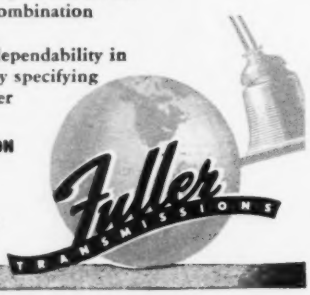

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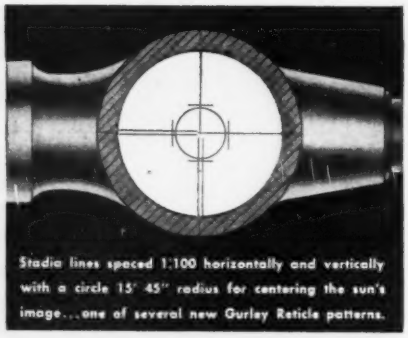

Stadia lines spaced 1:100 horizontally and vertically with a circle 15' 45" radius for centering the sun's image...one of several new Gurley Reticle patterns.

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Elections and Activities

The following officers were elected for the Southern Section of the Sewage Plant Operators of Illinois: chairman, Charles E. Mathis, superintendent of sewage, DuQuoin; vice-chairman, Ovid Ruhmann, superintendent of sewage, Belleville; secretary, W. H. Kibler, superintendent of sewage treatment Harrisburg.

B. B. Dunlap, Columbia, S. C., has been appointed assistant executive secretary of the Carolinas branch of the Associated General Contractors of America, Inc. In 1942 he was connected with the Corps of Engineers with whom he handled various assignments throughout the South Atlantic Division and later was overseas on air base and hospital construction.

Charleston Contractor's Association of South Carolina has elected the following: Eugene G. Skinner, president; Ralph B. Simmons, vice-president; Thomas A. Hayden, secretary.

N. J. Greene, National Electric Coil Co., has been elected president of the Columbus, Ohio, Technical Council, which comprises 12 technical societies (including A.S.C.E., Franklyn County chapter). Others elected are Charles F. Lucks, Battelle Memorial Institute, vice-president; and Fred R. Shackleton, Penn Welding Co., secretary-treasurer. E. L. Combs, Buckeye Finishers' Supply Co., editor of the CTC News.

G. F. Bayes, director of construction of the M. W. Kellogg Co. was recently elected president of the newly-formed National Constructors Association, 277 Broadway, New York City. Members of the association are nationally known general contractors, engaged in building oil refineries, steel and chemical plants and related construction. R. F. Carter, general superintendent of the Lummus Co. was elected vice-president and C. B. Bronson, secretary-treasurer.

I. J. Bowman has been elected president of the Marion, Ind., Contractors Association. Other officials include Glen Curren, vice-president; L. B. Draper, secretary. One-year directors include Earl Harreld, F. W. Irving, Everett Keesling, Purcell Younts and Homer Clark. Two-year directors named are Robert Botkins, Wilbur Feighner, Ed Moorhead, James Meredith, Ralph Andrews and Dan Liniger.

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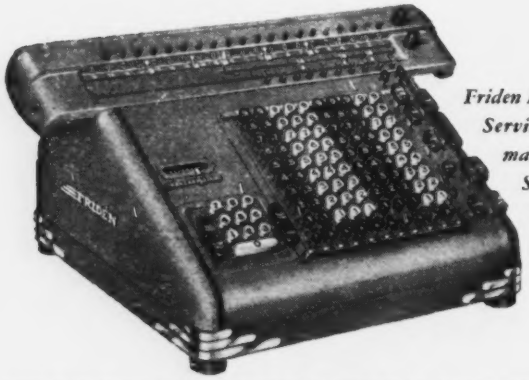

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Manufacturers' Activities

Appointment of Roger G. DeLong as manager and of W. B. Gibson as sales manager of the hydraulic division of the TWIN DISC CLUTCH CO. at Rockford, Ill., has been announced.

RAYBESTOS-MANHATTAN, INC., recently announced the following appointments in its equipment sales division: Harry C. Dishman, equipment sales manager with headquarters in Detroit; George T. Young, branch manager of the Detroit office; E. E. Juergens, branch manager of the Cleveland office; and John E. Cole, branch manager of the Chicago office.

LEE BARTHOLOMEW, veteran of more than 20 years in the building materials field, has been named vice-president in charge of sales for the Southern States Iron Roofing Co. During the recent war he was a consultant on emergency Maritime Commission housing in Florida, Alabama, Mississippi and Texas. He was formerly assistant general sales manager for the Celotex Corp.

JAMES C. VOSBURGH, SR., vice president of the Chicago Bridge & Iron Co., has been transferred from the Los Angeles office of that organization to Chicago and has been made president of the Guardite Corp., an affiliate. Mr. Vosburgh was in charge of the company's Washington office from 1940 until 1946, when he moved to the Los Angeles office.

F. G. HOYT has been appointed general manager of the woven wire fabrics division of John A. Roebling's Sons Co., Trenton, N. J. He will be assisted by J. Fennell Berger, assistant manager of sales, and by F. Clifford Peet, superintendent of production.

CLIFFORD N. PETERSON has been appointed direct factory representative of the American Hoist & Derrick Co., covering the Pacific Coast area from San Francisco.

JOHN M. WILKERSON has been appointed southern sales manager of the Pennsylvania-Dixie Cement Corp. with headquarters 1410 Rhodes-Haverty Building, Atlanta, Ga.

Henry J. Kaiser's PERMANENTE METALS CORP. has announced the de-